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NATIONAL DAM SAFETY PROGRAM. STRUCTURE NUMBER 1 - LITTLE SNI-A---ETC(U)
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STRUCTURE NO. 1 - LITTLE SNI-A-BAR CREEK

LAFAYETTE COUNTY, MISSOURI

MO 10480

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.

FOR: STATE OF MISSOURI

SEPTEMBER, 1978

UNCLASSIFIED

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Structure No. 1 Little Sni-A-Bar Creek Lafayette County, Missouri (MO 10480)		5. TYPE OF REPORT & PERIOD COVERED 9 Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		8. CONTRACT OR GRANT NUMBER(s) 15 DACW43-78-C-0155
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 12 41
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101 11		12. REPORT DATE Sep~~tember 19~~78
		13. NUMBER OF PAGES Approximately 95
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 10 Harold P. Hoskins		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

6 National Dam Safety Program. Structure Number 1 - Little Sni-A-Bar Creek (MO 10480), Missouri - Kansas City Basin, Lafayette County, Missouri. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: STRUCTURE NO. 1 - LITTLE SNI-A-BAR CREEK
PHASE I INSPECTION REPORT

This report presents the results of field inspection and evaluation of Structure No. 1 - Little Sni-A-Bar Creek:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 30 NOV 1978
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 30 NOV 1978
Colonel, CE, District Engineer — Date

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Structure No. 1 - Little Sni-I-Bar Creek
State Located	Missouri
County Located	Lafayette County
Stream	Little Sni-I-Bar Creek
Date of Inspection	September 15, 1978

Structure No. 1 - Little Sni-I-Bar Creek was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends ten miles downstream of the dam. Within the damage zone are three to four houses, six improved road crossings, and one railroad crossing. The floodplain is farmed.

~~Our~~ inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will pass the 100-year frequency flood without overtopping the dam. The spillways will also pass 39% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Additional deficiencies, in accordance with the guidelines, are the lack of seepage and stability analysis. These analyses should be obtained in the future.

Deficiencies visually observed by the inspection team were trees and shrubs growing on both slopes, small rills and washes on both slopes, several rodent holes on the downstream slope, logs and trash lodged around the trash rack of the principal spillway riser and some erosion and/or sloughing along the east bank of the stilling basin.

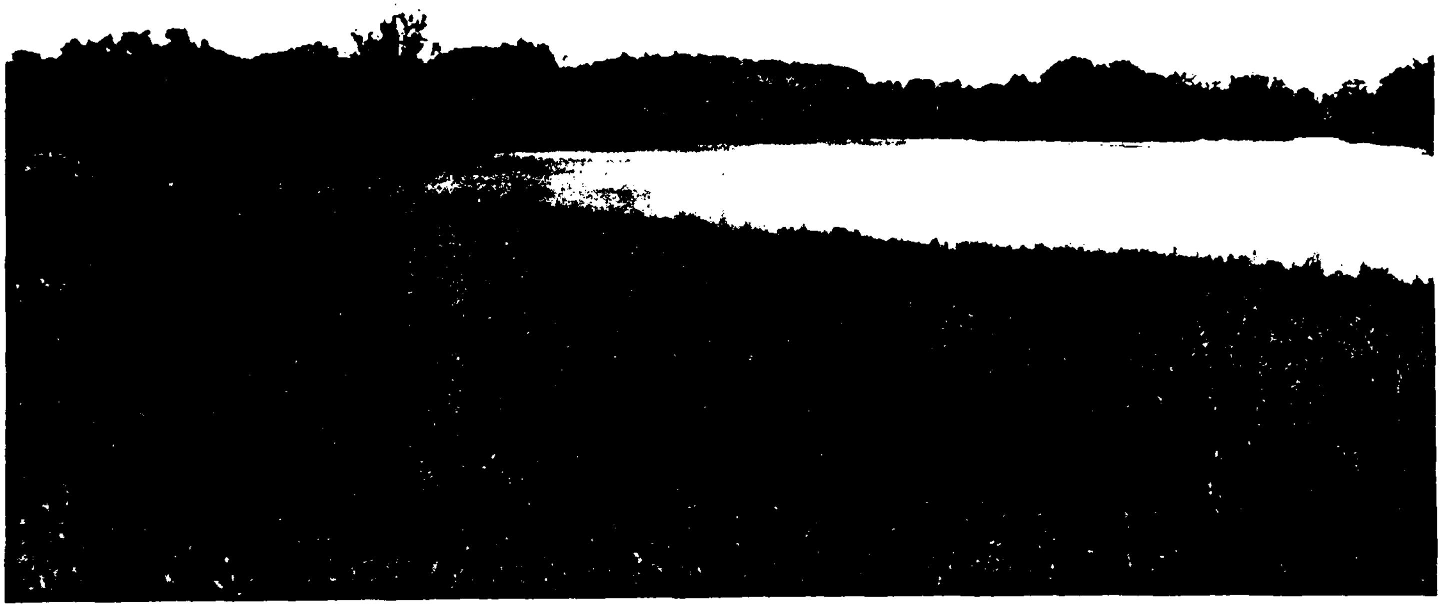
Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report.

H. P. Hoskins

Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

SUBMITTED BY SIGNED — Chief, Engineering Division — 30 NOV 1978 — Date

APPROVED BY SIGNED — Colonel, CE, District Engineer — 30 NOV 1978 — Date



PHOTOGRAPH NO. 1
OVERVIEW
FROM WEST UPSTREAM SIDE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STRUCTURE NO. 1 - LITTLE SNI-I-BAR CREEK
ID NO. MO. 10480

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Structure No. 1 - Little Sni-I-Bar Creek be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in " Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

(1) The dam is a compacted earth fill approximately 1200 feet long with maximum height of about 50 feet. Topography adjacent to the dam is moderately steep to gently rolling. Upland soils consist of silty clay loess (CL or ML). Soils on the slopes are derived from loess. Shale and limestone underlie the surface soil deposits.

(2) The primary or principal spillway consists of a reinforced concrete riser (drop inlet) with a 48 inch diameter reinforced concrete pipe conduit outlet.

(3) The emergency spillway consists of a vegetated earth channel cut into CL loess on the left (west) abutment. It has a bottom width of 350 feet and side slopes of 3H on 1V.

b. Location. The dam is located in the central portion of Lafayette County, Missouri, as shown on Plate 2. The dam is shown on Plate 1 in the NE¼ of Section 8 and the NW¼ of Section 9, T49N, R27W. The lake formed by the dam is shown in the E½ of Section 8, the NE¼ of Section 17, the W½ of Section 9 and the W½ of Section 16, T49N, R27W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the intermediate size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends ten miles downstream of the dam. Within the damage zone are three to four houses, six improved road crossings and one railroad crossing. The floodplain is farmed.

e. Ownership. The dam is owned by the Lafayette County Soil and Water Conservation District, 120 West 19th St., Higginsville, Missouri 64037.

f. Purpose of Dam. The purpose of the dam is flood control.

g. Design and Construction History. The dam was constructed in 1973. The design and plans for construction were prepared by the Soil Conservation Service (SCS), Columbia, Missouri. Portions of these plans are included with this report as Appendix C.

h. Normal Operating Procedure. All spillways are uncontrolled and the permanent pool level is dependent upon runoff and evaporation.

1.3 PERTINENT DATA

a. Drainage Area - 9200 Acres (SCS value checked by consultant).

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled reinforced concrete riser drop inlet principal spillway (4' x 12' riser opening) and a grassed earth channel ungated emergency spillway (350' bottom width).

(2) Estimated maximum flood at damsite - unknown.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 774 feet to 349 c.f.s. at the crest of the emergency spillway (788.6 feet).

(4) The principal spillway capacity at maximum pool elevation (794.24) is 375 c.f.s. Maximum pool elevation is that design value for freeboard pool level as furnished on SCS as-built plans.

(5) The total spillway capacity at maximum pool elevation is 12200 c.f.s.

(6) The total spillway capacity at maximum pool elevation is 12600 c.f.s.

c. Elevations (Feet above M.S.L.)

(1) Top of dam - 796.0 (SCS plans) - 795.8 (Survey 15 September, 1978).

(2) Principal spillway crest - 774.0.

(3) Emergency spillway crest - 788.6.

(4) Streambed at centerline of dam - 746 ±.

(5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 13000 feet ±.

e. Storage (Acre-feet). Top of dam - 6700.

f. Reservoir Surface (Acres).

(1) Top of dam - 555 acres±.

(2) Spillway crest (principal) - 105±
(emergency) - 319±.

g. Dam

(1) Type - earth embankment.

(2) Length - 1200 feet ±.

(3) Height - 50 feet ±.

(4) Top width - 14 feet.

(5) Side Slopes

(a) Downstream - 2.5H on 1V with 10 foot berm at elevation 762 feet

(b) Upstream - 2.5H on 1V with 10 foot berm at elevation 770 feet

(6) Zoning - none (homogeneous embankment)

(7) Impervious Core - all embankment material shown as silty clay (CL).

(8) Cutoff - The plans show cutoff varying in depth from 4 to to 15 feet with 12 foot bottom width and side slopes varying from 1H on 1V to 3H on 1V.

(9) Grout curtain - none.

(10) Drains - Plans show foundation and embankment (chimney) drain on the right abutment (centerline station 14+20 to 15+70±).

(11) Wave Protection - Riprap from elevation 770 to 779.

h. Diversion Channel and Regulating Tunnel. None

i. Spillway

(1) Principal

(a) Type - Uncontrolled drop inlet (4.0 feet width x 12.0 length x 15.0 feet depth) reinforced concrete riser with rectangular weir orifice inlet and a 48 inch reinforced concrete pressure pipe.

(b) Size of weir orifice - 4 5.75 feet length sections.

(c) Crest elevation - 774.0 M.S.L.

(2) Emergency

(a) Type - standard SCS grassed earth channel with case 4 approach channel profile and splitter dike (2 feet high, 8 feet crest width, and 3:1 side slopes) extending downstream from control section on centerline (see SCS plans appendix).

(b) Control section - 350 foot bottom width; 3(h):1(v) left bank and 2.5:1 right bank.

(c) Crest elevation - 788.6 feet M.S.L.

(d) Upstream channel - 43° curved channel in good condition.

(e) Downstream channel - heavy grass in good condition.

j. Regulating Outlet

(1) Principal Spillway

(a) Reinforced concrete inlet (inlet invert elevation 760.0) with 24-inch diameter R/C pipe.

(b) 24-inch diameter rising stem slide gate and 24-inch diameter removable handwheel with lift (see as-built plans) at outlet into riser (outlet invert elevation 760.0).

(2) Emergency Spillway - none.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Data on the Geologic and Soil Mechanics investigation, hydraulic/hydrologic computations and "as-built" construction plans were supplied by the SCS, Columbia, Mo. This information is shown in Appendix C and Appendix D.

2.2 CONSTRUCTION

No construction data were readily available; however, it is reported that the dam was constructed with SCS engineering supervision and standard inspection and quality control procedures.

2.3 OPERATION

All spillways are uncontrolled. It was reported that the emergency spillway has not operated and that the maximum pool level was about 3 feet above the level of the riprap (elevation 782 feet ±) in the spring of 1978.

No information was available on operation of the regulated drain or drawdown system.

2.4 EVALUATION

a. Availability. The engineering data shown in Appendix C were readily available from the SCS, Columbia, Mo.

b. Adequacy. The available data are considered adequate to assess the design and stability of the structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The available engineering data for this structure are considered valid.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Structure No. 1 - Little Sni-I-Bar Creek was made on September 15, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey Decker, Geology and Soil Mechanics; Garold Ulmer, Civil Engineer; Richard Walker and Gordon Jamison, Hydrology. Mr. Struchtemeyer, landowner on the east side of the dam, assisted the inspection party with access to the dam.

Results of the visual inspection are summarized below. Photographs are shown in Appendix B.

b. Dam. Rough measurements of the profile along the crest of the dam and emergency spillway centerline and cross-sections of the embankment and spillway indicate that the dam was constructed according to the plans shown in Appendix C.

The plans show a constructed embankment crest elevation of 796.0 feet with a settled crest elevation of 794.4. Measurements along the centerline of the dam indicate that the crest elevation is 795.8 feet from about ℄ stations 7+00 to 18+00, the right (east) abutment (stationing according to plans). The crest elevation of the embankment extension on the left end along the emergency spillway was measured as 795.3 feet. (Crest elevations are based upon principal spillway crest elevation of 774.0)

The dam is covered with an excellent growth of adapted grasses and legumes.

A few small trees and shrubs were observed on the downstream slope. Several small cottonwood trees are gowing along the water-line on the upstream slope.

Several small rills and washes were observed on both slopes of the dam. These probably result from small drying cracks that were also observed on the crest and slopes of the dam. Several rodent holes were also observed on the downstream slope.

The foundation - embankment drain was not discharging at the time of the inspection. There were no indications of seepage on the downstream slope or along the toe of the dam.

No slips, sloughs or abnormal deformations were observed on the embankment or abutments.

The riprap on the upstream slope appeared to be in good shape.

c. Appurtenant Structures

(1) Principal spillway. There were no indications of spalling or deterioration of the principal spillway riser nor the concrete pipe outlet. The lake level was just below (0.1 ft.) the crest elevation of the spillway at the time of the inspection. A number of logs and tree branches, up to 6 inches in diameter, were lodged around the trash rack of the spillway.

The riprap in the stilling basin appeared to be satisfactory. Some erosion and/or sloughing was noted on the right (east) bank of the stilling basin about 30 feet downstream from the spillway outlet and above the level of the riprap.

(2) Emergency spillway. The emergency spillway is well vegetated with adapted grasses and legumes. A splitter dike about 3 feet high is located along the centerline of the spillway. The spillway looks very good with no evidence of erosion or slides in the bottom or side slopes.

(3) Drawdown facility. The plans show a 24 inch R/C pipe entering the base of the principal spillway riser. Flow through this system is controlled by a 24 inch rising stem slide gate. This system is designed as a drawdown facility to evacuate the reservoir. It is not known whether or not the gate is operable.

d. Reservoir Area. No excessive wave wash, or erosion or slides were observed along the shore of the reservoir.

e. Downstream Channel. The channel downstream from the principal spillway appeared to be open and unobstructed.

3.2 EVALUATION

None of the conditions observed indicate a need for immediate remedial action. Trees and shrubs on both slopes and logs and trash around the inlet to the principal spillway are deficiencies which could ultimately impair the integrity of the dam and/or the intended operation of the spillways if left uncontrolled or uncorrected.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool level is normally controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillways. Procedures for operating the drawdown facility are not known.

4.2 MAINTENANCE OF DAM

The dam is reasonably well maintained. Action should be taken to correct the minor deficiencies noted in Sections 3 and 7.2.

4.3 MAINTENANCE OF OPERATING FACILITIES

It is not known if the drawdown facility is operable nor if and when the system has been operated.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The dam and appurtenances appear to be well maintained with the exception of some laxity in controlling tree growth on the embankment and allowing trash and logs to accumulate around the principal spillway inlet. Controlling vegetation on the embankment slopes will facilitate inspection and evaluation (for repair) of rodent holes and rill erosion.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Pertinent hydraulic and hydrologic data which were taken from as-built plans furnished by the SCS are tabulated in Appendix D as Hydrologic Computations. The supporting computations are attached.

b. Experience Data. The drainage area and elevation-storage curve were taken from the SCS as-built plans. The reservoir water surface areas were developed from the USGS Odessa North 7 1/2' quadrangle and compared with the as-built. The hydraulic computations for spillways and dam overtopping discharge ratings were based on the data taken from the as-built plans. Surveys made during the field inspections revealed no major discrepancies as far as the structural components of the dam and spillways were concerned.

c. Visual Observations.

(1) Principal and emergency spillways are in good condition.

(2) The emergency spillway does not appear to have ever been used.

(3) The emergency spillway channel exit is in the left hillside approximately 600 feet downstream from the dam toe. Spillway releases will not endanger the integrity of the dam.

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. One-half the PMF will overtop the dam a maximum of 1.3 ft. and for a period of 3.4 hours. The spillways will pass 39% of the PMF without overtopping the dam. The existing spillways will pass the 24-hour 100-year frequency flood without overtopping. The results of the routings through the dam are tabulated in regards to the following conditions. Since the spillway is not capable of passing a minimum of one-half of the PMF without overtopping the dam and causing failure, the spillway is considered seriously inadequate and the dam is accordingly considered unsafe.

Frequency	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation	Top of Dam Min. Elev. 794.4	Time Dam Overtopping Hrs.
100 Yr.	11,600	2,500	790.6	+3.8	-
1/2 PMF	26,900	18,500	795.7	-1.3	3.4
PMF	54,300	47,400	798.4	-4.0	5.9
0.39 PMF	21,000	13,200	794.4	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillways.

The St. Louis District, Corps of Engineers, in a letter dated 13 August, 1978 has estimated the damage zone as extending ten miles downstream from the dam. Within the damage zone are three to four houses, six improved road crossings and one railroad crossing. The floodplain is farmed. Field inspection verified this.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Maintenance features that could affect the long time safety of the dam are discussed in Section 3.2.

Hydraulic/hydrologic analyses presented in Section 5 indicate that the dam will be overtopped by the probable maximum flood with settled crest elevation of 794.4 feet. Under those conditions, water would flow over the top of the dam to a maximum depth of 4 feet for about 6 hours. It is doubtful that this structure could withstand such flows without seriously impairing the structural stability of the dam.

b. Design and Construction Data. The engineering data, analyses, and plans supplied by SCS conform with accepted practice and are considered adequate to assess the structural stability of the dam. There is no reason to question the adequacy of construction supervision and quality control.

c. Operating Records. There are no appurtenant structures that require operational functions.

d. Post Construction Changes. The inspection party is not aware of any post construction changes.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The few deficiencies in maintenance that were observed, a few small trees on the embankment slopes and logs around the inlet to the principal spillway, should be corrected or controlled. With the assumptions used for the hydrologic analyses, the probable maximum flood (PMF) will overtop the dam. Under present conditions, the flood resulting from 1/2 PMF will overtop the left end of the dam to a depth of 1.3 feet.

b. Adequacy of Information. The information presented in this report is considered adequate to assess the safety of the structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. There does not appear to be an immediate urgency to accomplish the remedial measures discussed in paragraph 7.2.

d. Necessity for Phase II. Based on the results of the Phase I inspection, Phase II investigations are not considered necessary.

e. Seismic Stability. An earthquake of the magnitude to be expected in this area should not be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) The size of the emergency spillway and/or the height of the dam should be increased to pass the probable maximum flood without overtopping the dam.

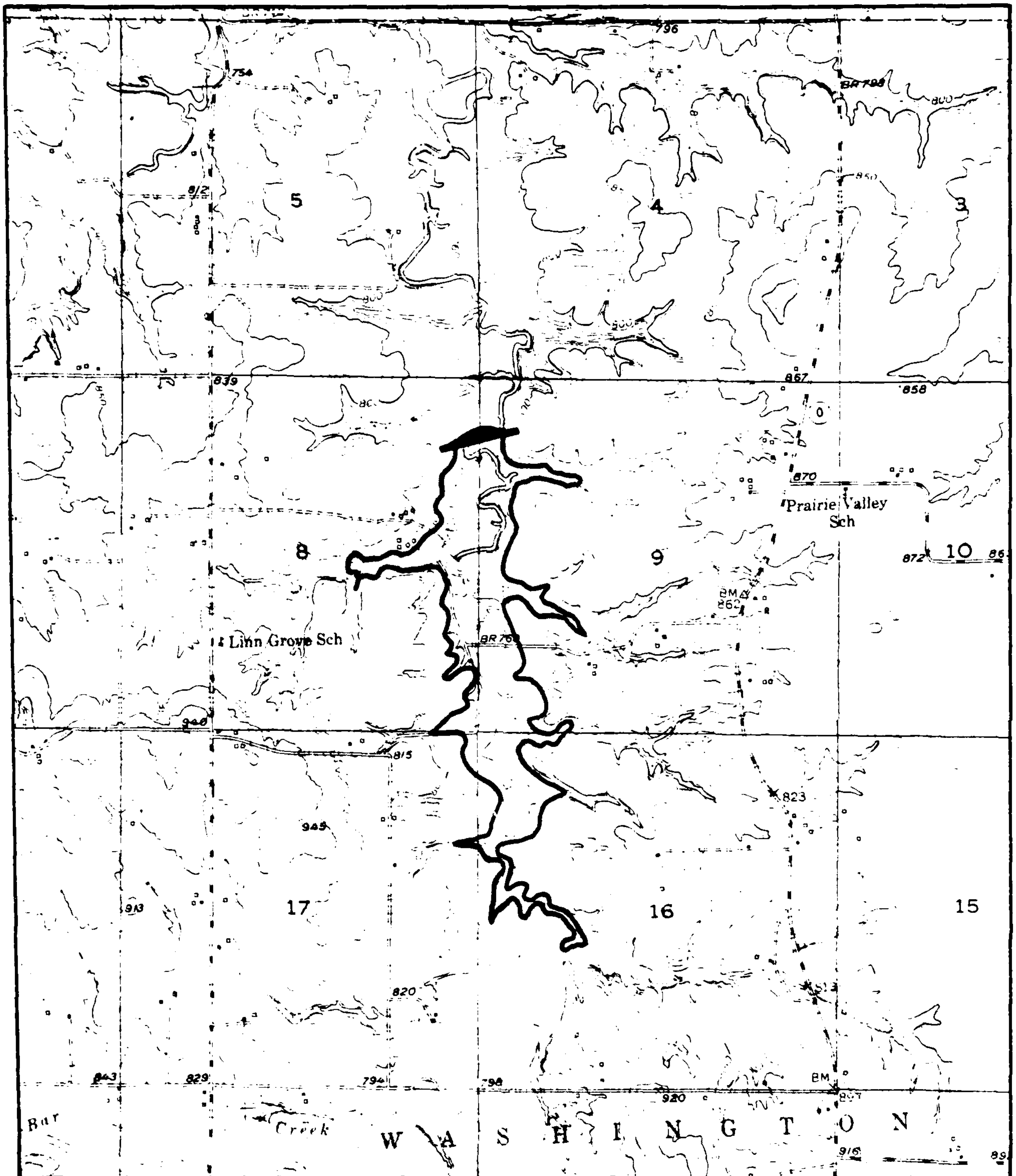
(2) Increasing the height of the dam on the left (west) end would allow passage of 0.5 of the probable maximum flood without overtopping the dam. Under this alternative it is recommended that surveys be conducted annually along the crest of the dam to monitor the settlement characteristics of this structure.

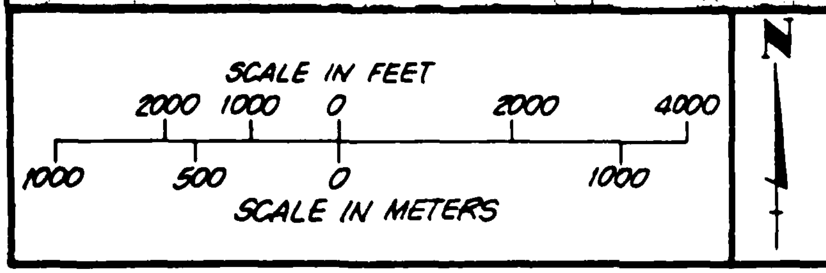
b. O & M Maintenance and Procedures.

(1) The trees should be removed from the slopes of the dam, and the logs and trash should be removed from the entrance to the principal spillway.

(2) A program of regular maintenance and inspection should be initiated. This program should be designed to control vegetation on the dam, keep the principal spillway open and repair rodent holes and rill erosion on the slopes of the dam.

APPENDIX A
MAPS

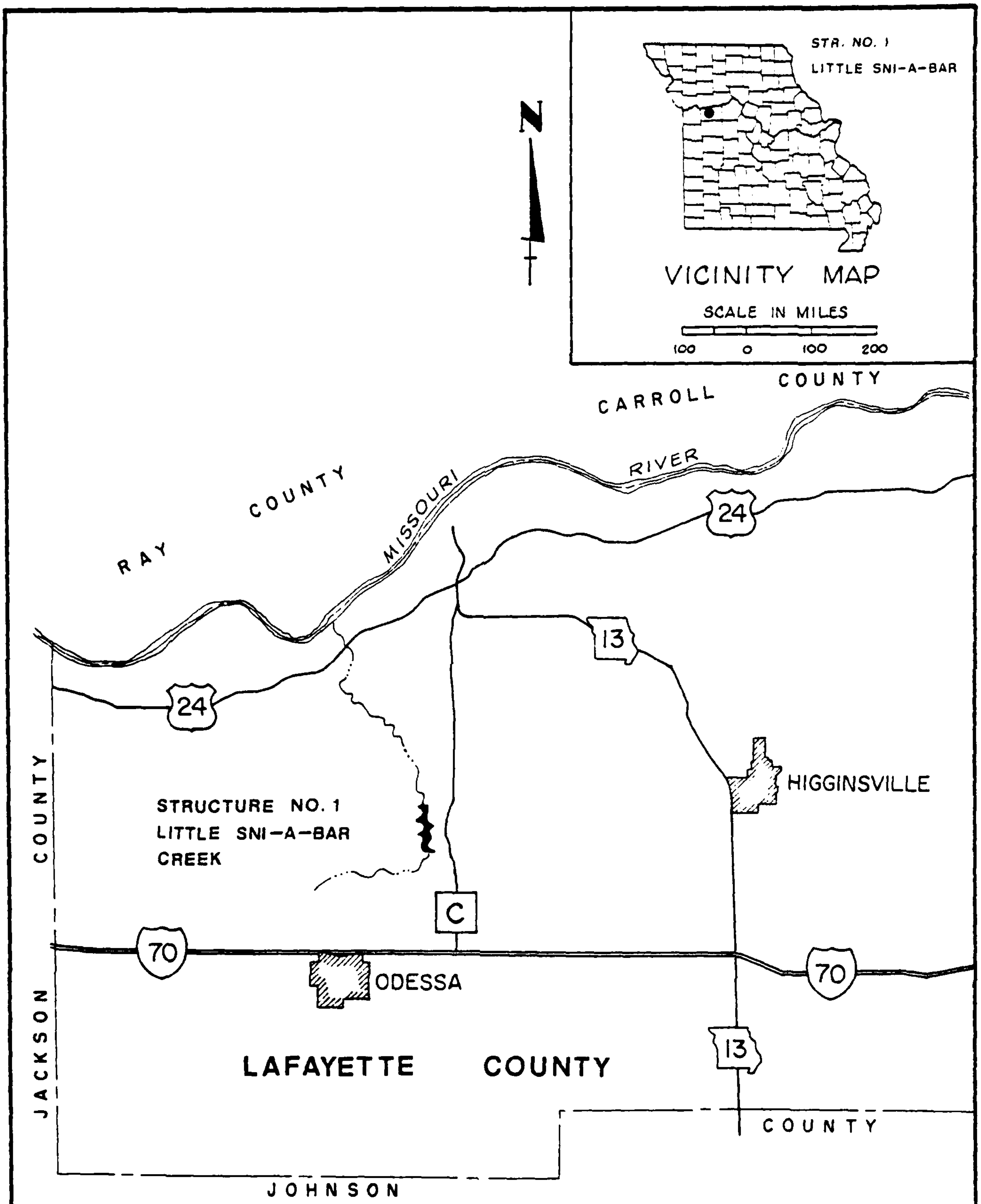




STRUCTURE NO. 1
LITTLE SNI–A–BAR
CREEK

VICINITY TOPOGRAPHY

PLATE 1



LOCATION MAP
PLATE 2

APPENDIX B
PHOTOGRAPHS

PHOTO. NO. 2
LOOKING EAST ACROSS EMERGENCY SPILLWAY FROM WEST ABUTMENT. SPLITTER DIKE IN CENTER OF PICTURE.

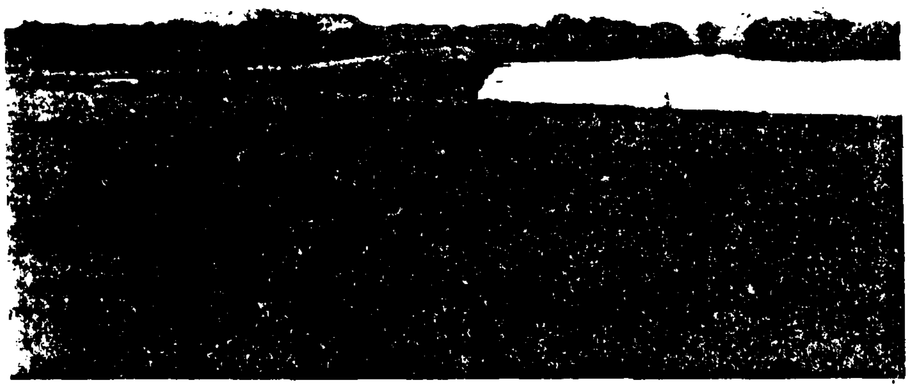


PHOTO. NO. 3
FOREBAY OF EMERGENCY SPILLWAY, CREST AND UPSTREAM SLOPE OF DAM FROM WEST ABUTMENT.

PHOTO. NO. 4
LOOKING UPSTREAM FROM CONTROL SECTION OF EMERGENCY SPILLWAY TOWARD WEST SIDE OF SPILLWAY.

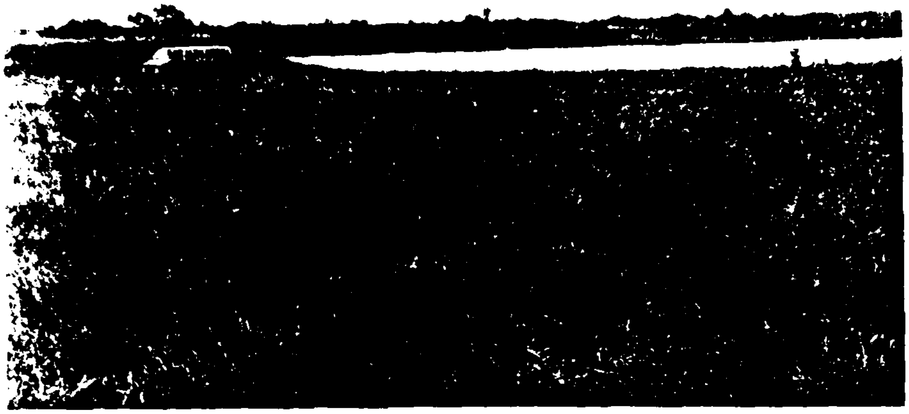


PHOTO. NO. 5
LOOKING UPSTREAM
INTO FOREBAY OF
EMERGENCY SPILLWAY
TOWARD EAST SIDE
OF SPILLWAY.

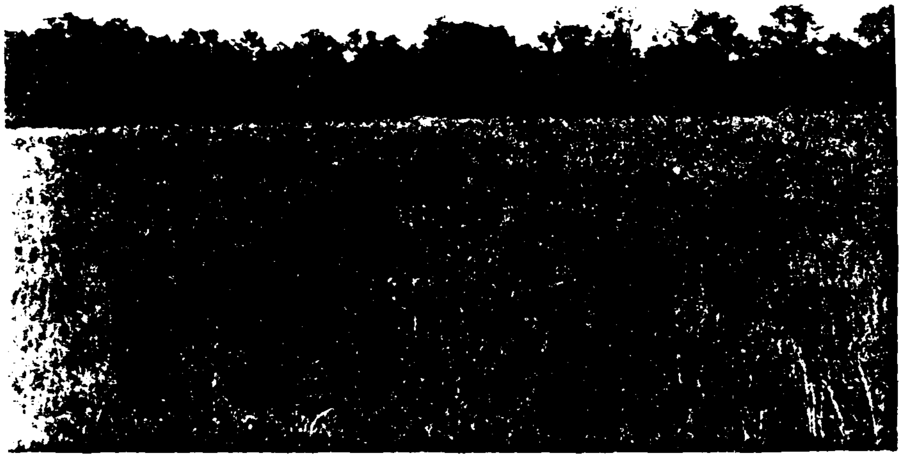


PHOTO. NO. 6
LOOKING DOWNSTREAM
ALONG CENTER LINE
OF EMERGENCY SPILLWAY.
SPLITTER DIKE IN
CENTER OF PICTURE.

PHOTO. NO. 7
DOWNSTREAM SLOPE
FROM WEST.

PHOTO. NO. 8
LOOKING UPSTREAM
AT PRINCIPAL
SPILLWAY RISER.

PHOTO. NO. 9
LOOKING DOWNSTREAM
AT PRINCIPAL SPILLWAY
OUTLET.

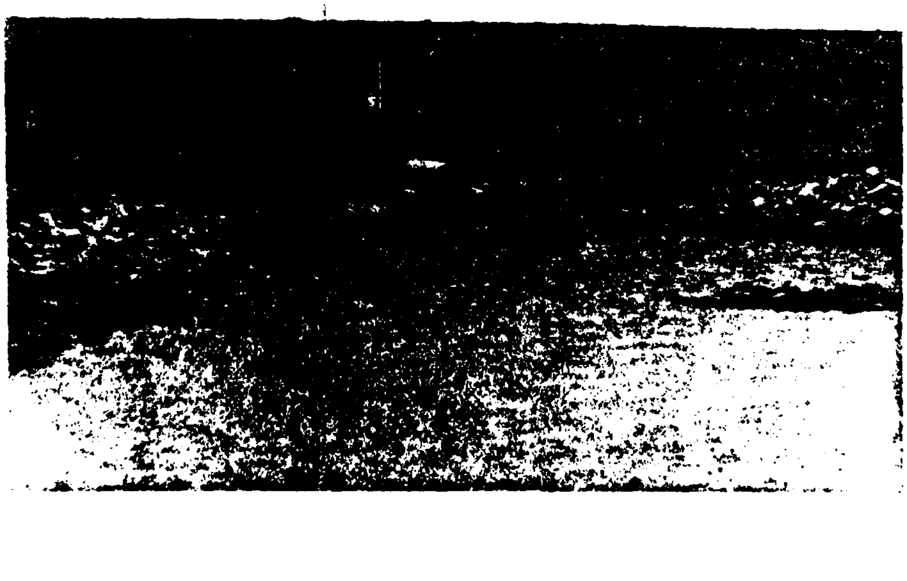


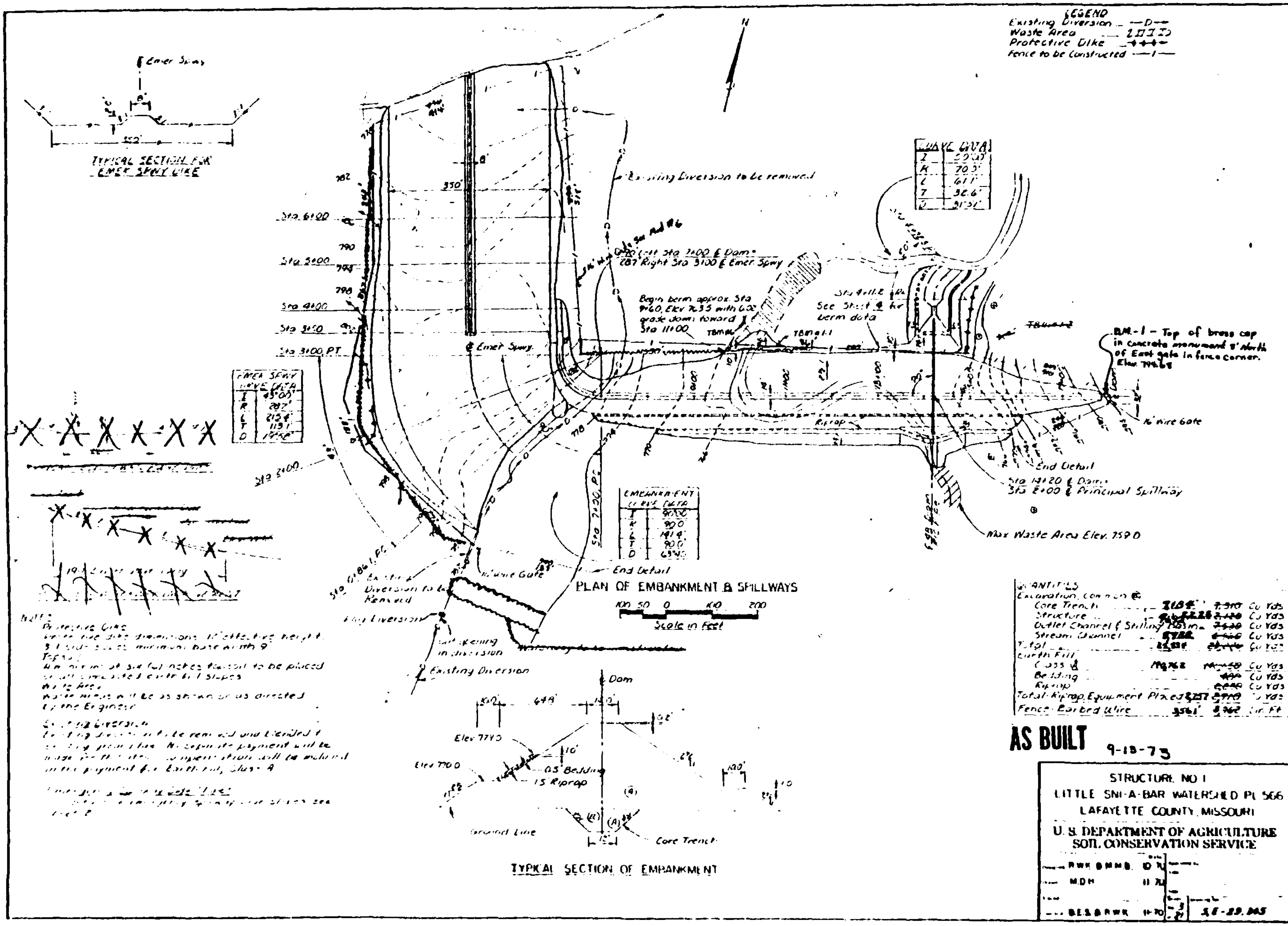
PHOTO. NO. 10
LOOKING UPSTREAM
AT PRINCIPAL SPILLWAY
OUTLET.

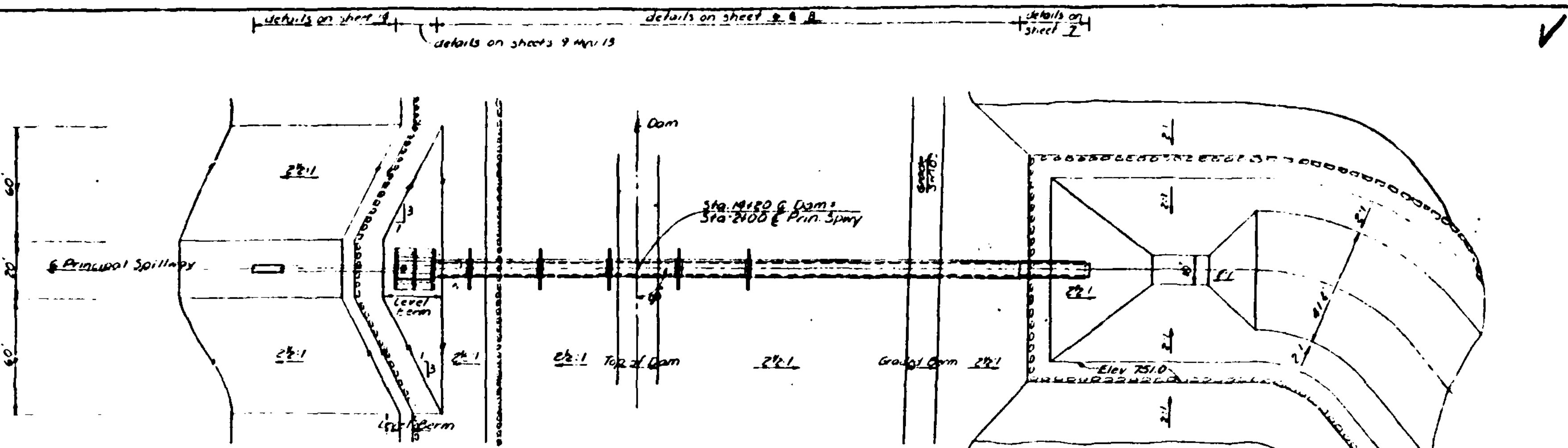
PHOTO. NO. 11
LOOKING EAST ACROSS
STILLING BASIN AT
EROSION ON EAST BANK
OF BASIN ABOVE
RIPRAP.

PHOTO. NO. 12
UPSTREAM SLOPE
FROM WEST END.

PHOTO. NO. 13
RIPRAP ON UPSTREAM
SLOPE AND SMALL
COTTONWOOD TREES
IN FOREGROUND.

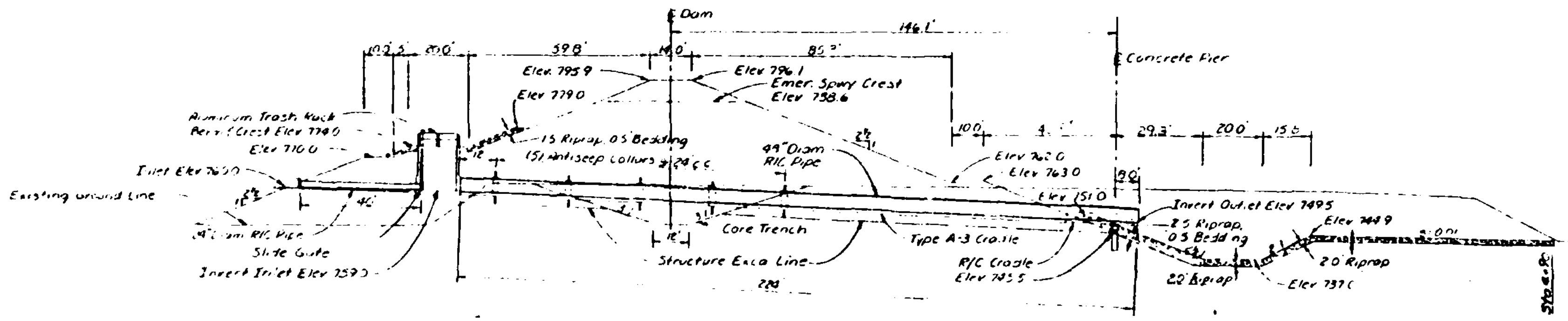
APPENDIX C
PLANS AND REPORTS


LEGEND
Existing Diversion
Waste Area
Protective Dike
Fence to be Constructed
TYPICAL SECTION FOR EMER SPWY DIKE
Existing Diversion to be removed
Begin berm approx. Sta 9+60, Elev 7.35 with 6.0% grade down toward Sta 11+00
See Sheet 4 for berm data
BM-1 - Top of brass cap in concrete monument 8' North of East gate in fence corner.
16' Wire Gate
End Detail
Sta 14+20 ℄ Dam
Sta 2+00 ℄ Principal Spillway
Max Waste Area Elev. 759.0
℄ Emer Spwy.
PLAN OF EMBANKMENT & SPILLWAYS
Scale in Feet
Existing Diversion
TYPICAL SECTION OF EMBANKMENT
Ground Line
Core Trench
.5 Bedding
1.5 Riprap
AS BUILT
9-13-73
STRUCTURE NO 1
LITTLE SNI-A-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



PLAN

Notes:
1 Camber conduit in accordance with the elevations given in the table below
2 Conduit elevations other than those shown will be furnished by the Engineer, when required
3 Antiseep collars shall not be placed closer than two (2) feet to a pipe joint



SECTION ON CENTERLINE

20 10 0 20 40
Scale in Feet

DISTANCE FROM OUTLET	ELEVATION	DISTANCE FROM OUTLET	ELEVATION
0	749 50	128	755 33
24	750 52	136	755 66
32	750 92	144	755 98
40	751 32	152	756 31
48	751 71	160	756 62
56	752 10	168	756 94
64	752 47	176	757 24
72	752 84	184	757 54
80	753 21	192	757 84
88	753 58	200	758 14
96	753 94	208	758 43
104	754 29	216	758 72
112	754 64	224	759 00
120	754 99		

PIPE CAMBER

QUANTITIES

Concrete - Class 4000	147.6 Cu Yds
Steel Bar Reinforcement	9478 Pounds
Pipe Conduit - Reinforced Concrete (Pressure) 49 Diam, Steel Ring Type Joint & Rubber Gasket	224 Lin Ft
Pipe Conduit - Reinforced Concrete (Pressure) 24 Diam, Steel Ring Type Joint & Rubber Gasket	40 Lin Ft
Aluminum Trash Rack	Lump Sum
Slide Gate, 24" Evom.	1 Each

AS BUILT

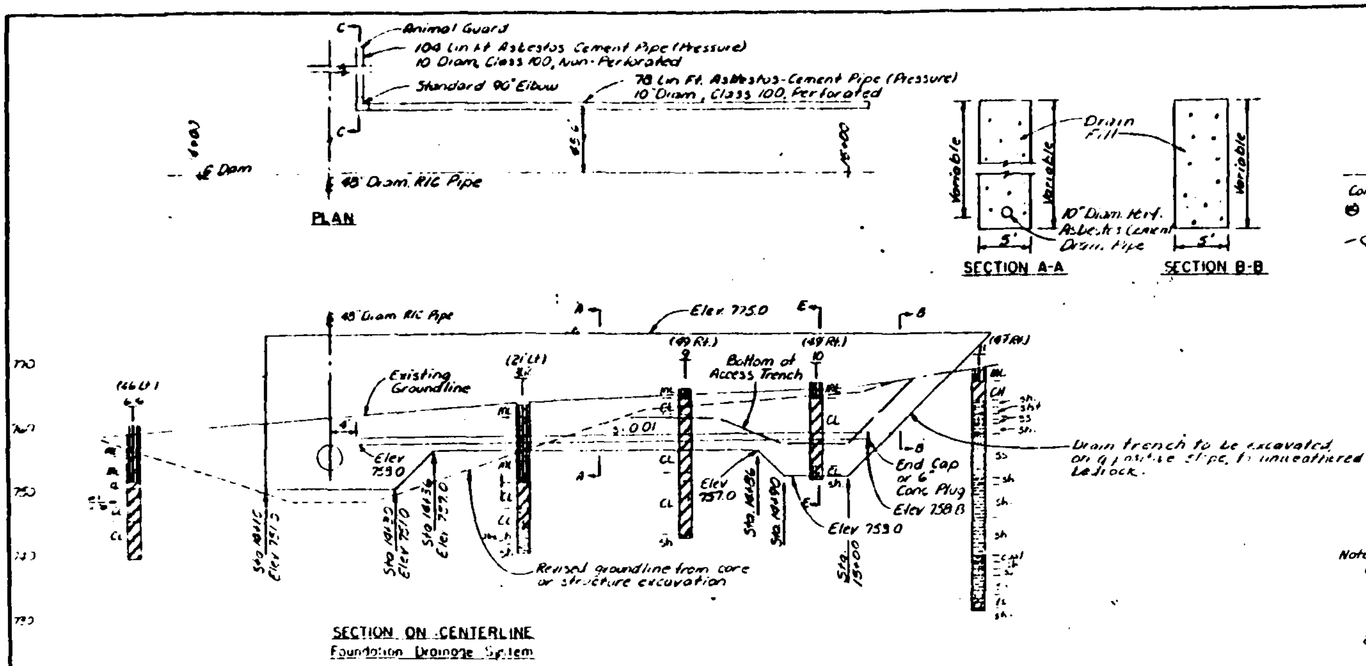
9-18-78

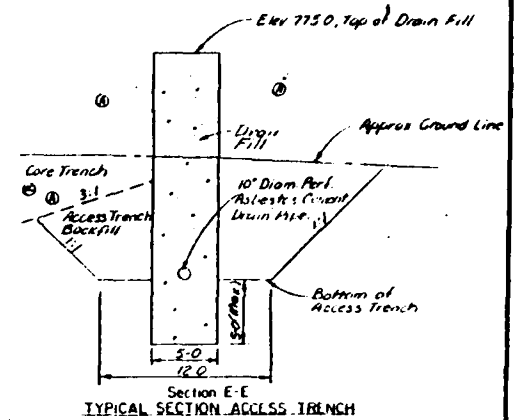
STRUCTURE NO 1

R/C DROP INLET FOR 48" DIAM PIPE
GENERAL LAYOUT
LITTLE SNI-A-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

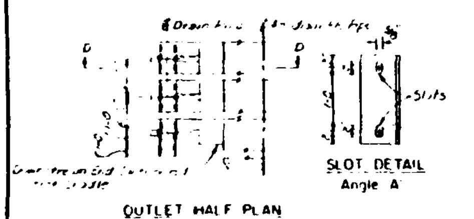
Designed RWK & MMB.	10-70	Approved by
Drawn MMB	10-70	Title
Traced MDH.	10-70	Checked
Checked BES, RWK & NHR	12-70	Sheet 4 of 21 · 5,E-29,945

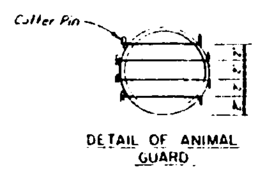




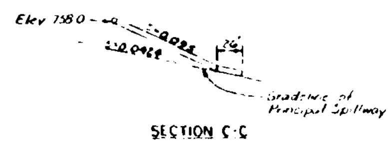
Notes:
1 The filter material shall be a reasonably well graded sand-gravel mixture with 35-60% passing a no 4 sieve, maximum size of 3".

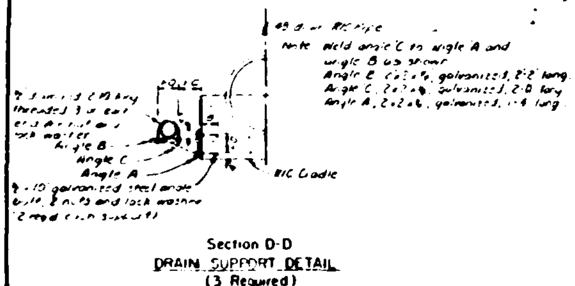
2 The soil material from the access trench shall be excavated, stockpiled and placed as backfill in the access trench. The backfill shall be compacted to its approximate original density. No separate payment will be made for this item. Compensation shall be included in the payment for Drain Fill.





Notes
1 Bars may be either size No. 3, size No 4 or ½" bolts
2 Bars are to be spaced horizontally on 2" centers and are to have a minimum bend of 1" at one end
3 The holes to receive the bars shall be 1½" from the end of the pipe





AS BUILT
9-13-73

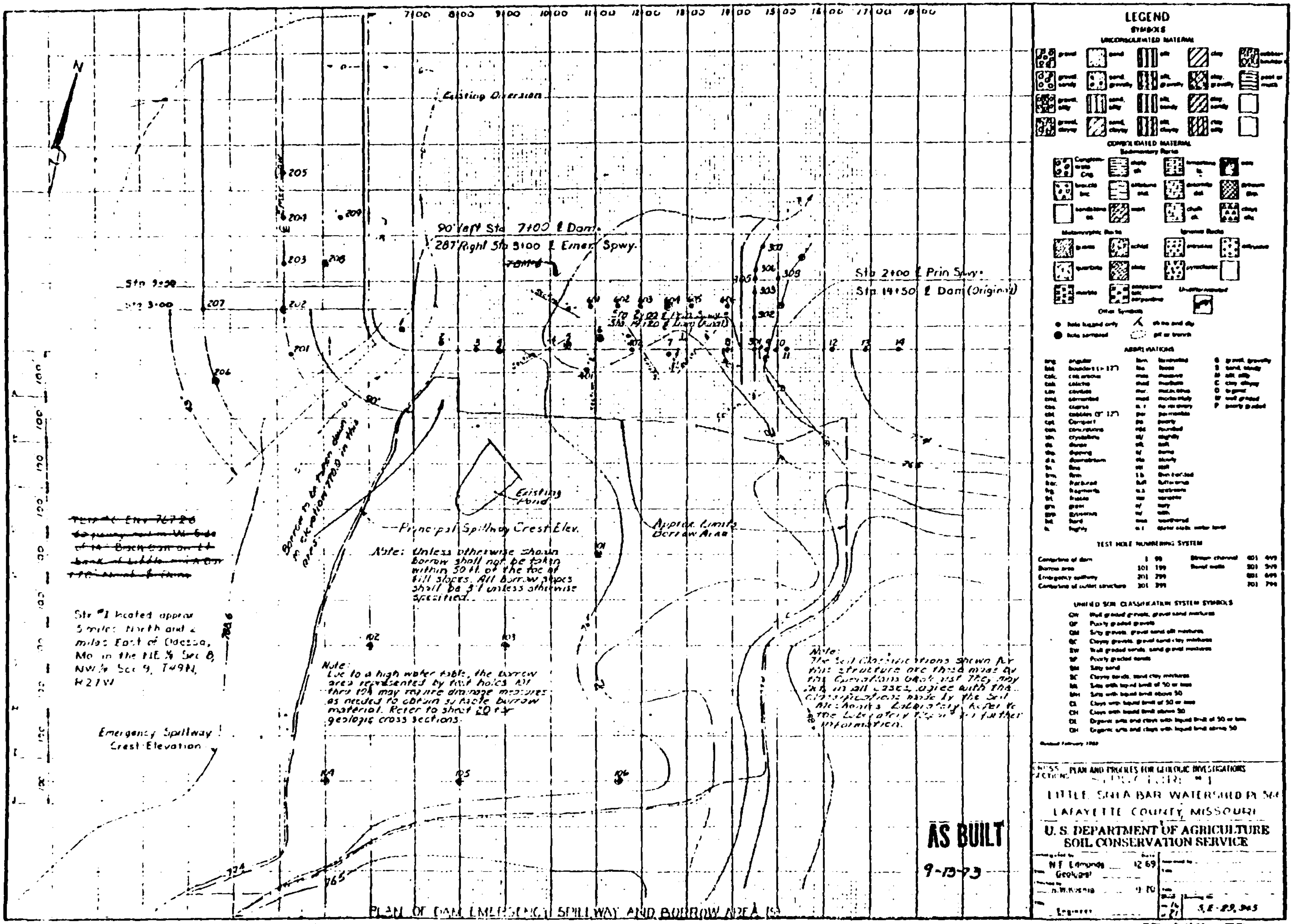
QUANTITIES

Pipe, Asbestos Cement (Pressure), 10 diam, Class 100 Perforated	75 Lin Ft
Pipe, Asbestos Cement (Pressure), 10 diam, Class 100, Non-Perforated	104 Lin Ft
Drain Fill-Filter Material	~~366~~ 446 Cu Yd

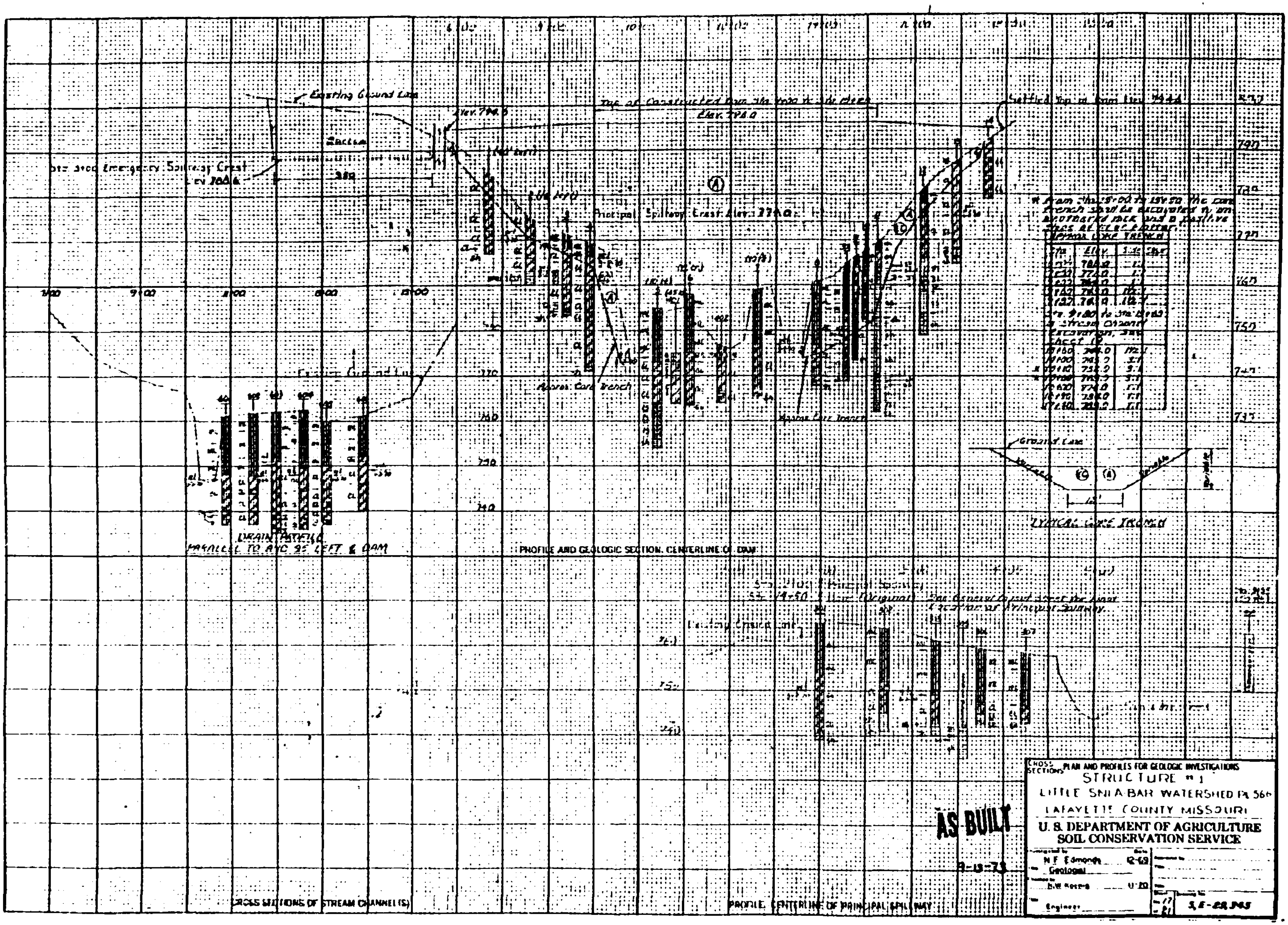
STRUCTURE NO 1
FOUNDATION DRAINAGE SYSTEM
LITTLE SNI A BAR WATERSHED P.L. 566
LAFAYETTE COUNTY, MISSOURI

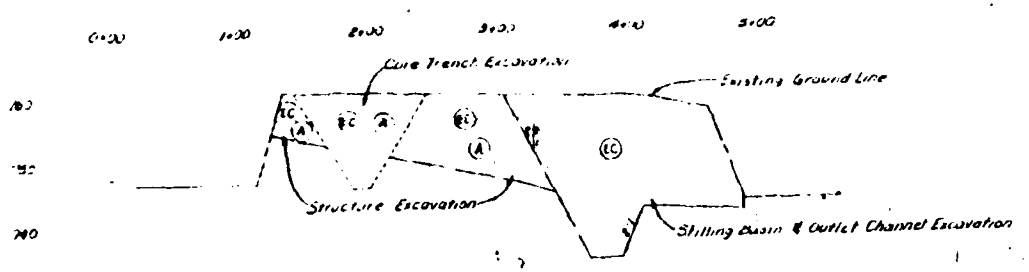
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RWK & MMB.	10-70	
MDH	10-70	
BES & RWK	11-70	5/21 5,E-29,345

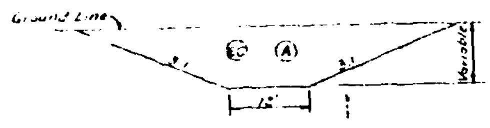


LEGEND
Existing Diversion
90' left Sta 7+00 ℄ Dam
287' Right Sta 3+00 ℄ Emer. Spwy.
Sta 2+00 ℄ Prin Spwy.
Sta 14+50 ℄ Dam (Original)
Existing Pond
Principal Spillway Crest Elev.
Approx. Limits Borrow Area
Borrow to be taken down to elevation 770.0 in this area
Note: Unless otherwise shown borrow shall not be taken within 50 ft. of the toe of fill slopes. All borrow slopes shall be 3:1 unless otherwise specified.
Note: Due to a high water table, the borrow area represented by test holes 101 thru 104 may require drainage measures as needed to obtain suitable borrow material. Refer to sheet 20 for geologic cross sections.
Note: The soil classifications shown for this structure are those made by the Geologist. They may not in all cases agree with the classifications made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.
Str #1 located approx 5 miles North and 2 miles East of Odessa, Mo. in the NE ¼ Sec 8, NW ¼ Sec 9, T49N, R27W
Emergency Spillway Crest Elevation
AS BUILT
9-13-73
TEST HOLE NUMBERING SYSTEM
UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS
PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
LITTLE SNI-A-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
N.F. Edmonds
Geologist
12-69
3-E-29,945
PLAN OF DAM, EMERGENCY SPILLWAY AND BORROW AREA


Existing Ground Line
Top of Constructed Dam
Elev. 794.0
Settled Top of Dam
Emergency Spillway Crest
Principal Spillway Crest Elev.
Across Core Trench
DRAIN OUTLET
PARALLEL TO AND LEFT ℄ DAM
PROFILE AND GEOLOGIC SECTION, CENTERLINE OF DAM
TYPICAL CORE TRENCH
Ground Line
CROSS SECTIONS OF STREAM CHANNEL(S)
PROFILE, CENTERLINE OF PRINCIPAL SPILLWAY
AS BUILT
CROSS SECTIONS PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
STRUCTURE #1
LITTLE SNI A BAR WATERSHED PL 566
LAFAYETTE COUNTY MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
N.F. Edmonds
Geologist
Engineer

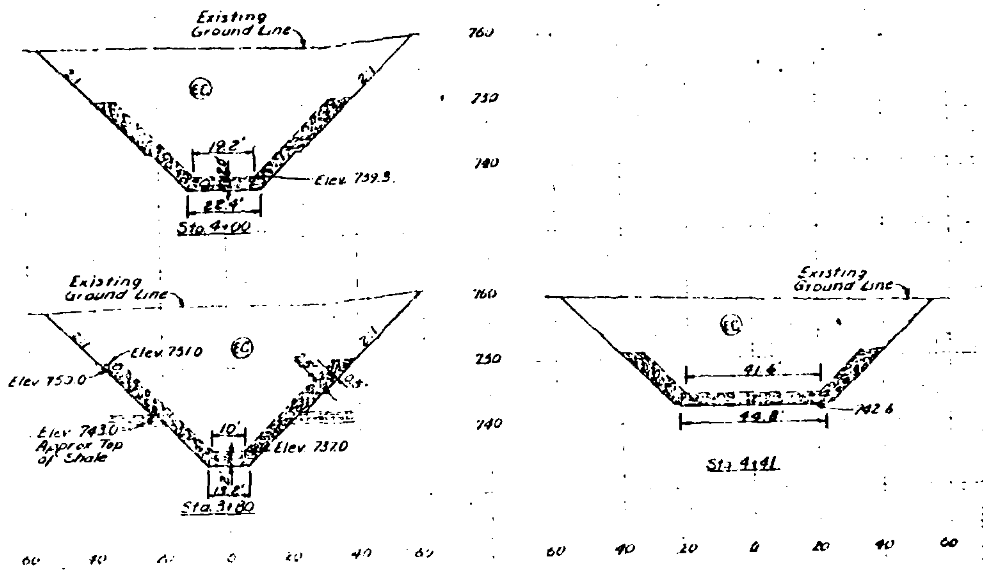


PROFILE ALONG ℄ PRINCIPAL SPILLWAY



TYPICAL STRUCTURE EXCAVATION

APPROX. STK. EXCA.		
Sta	Elev	Side Slope
1+30	755.0	3:1
3+17	747.0	3:1
3+46.1	745.5	3:1



CROSS SECTIONS STILLING BASIN & OUTLET CHANNEL

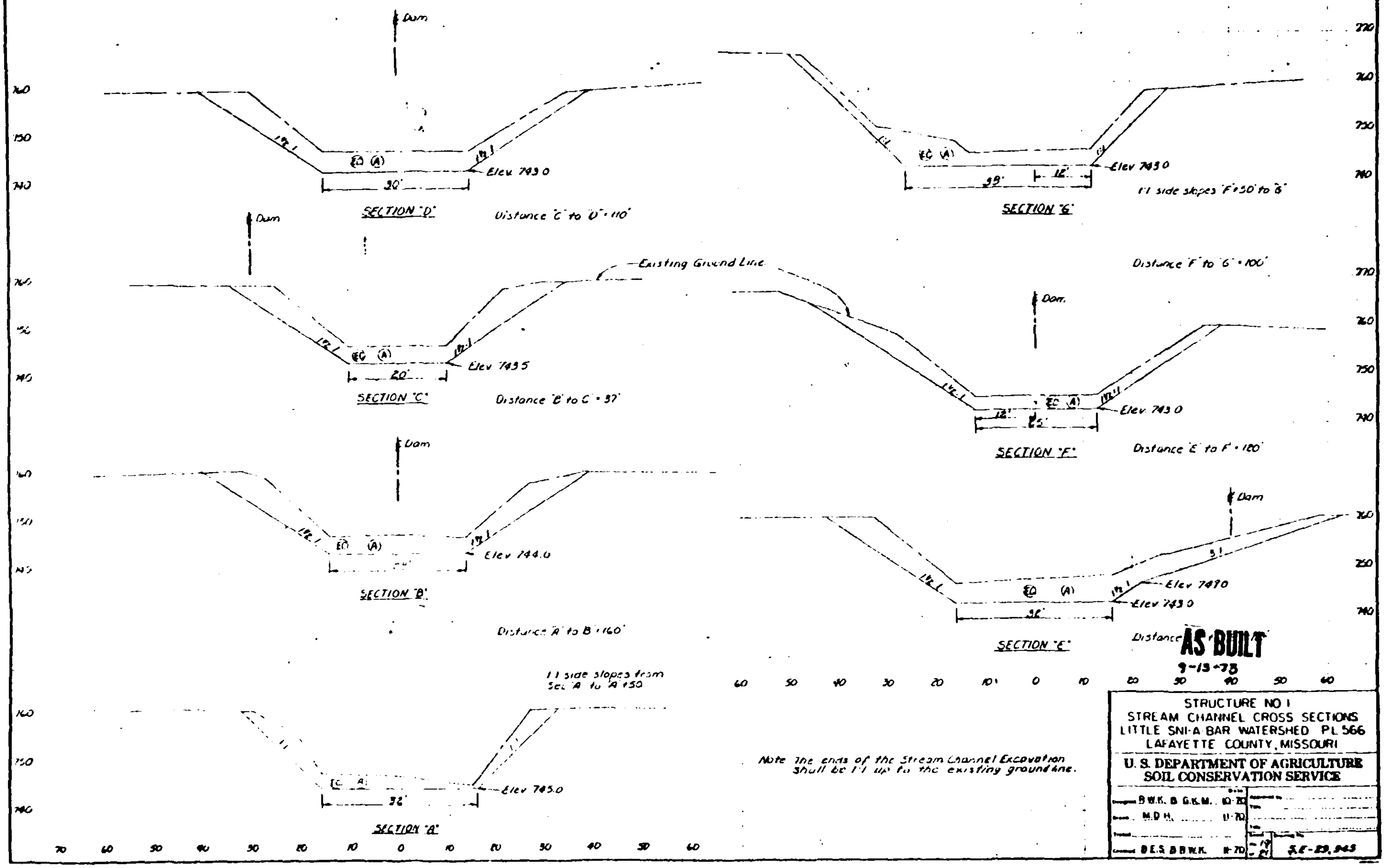
APPROX. EXCA.	
Sta	Elev
3+09.8	760.0
3+72.3	735.0
3+95.9	735.0
4+11.7	742.9
4+90	742.1 (742.1)

AS BUILT
9-18-73

STRUCTURE NO. 1

PRINCIPAL SPILLWAY EXCAVATION
LITTLE SNI-A-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SE-28,948

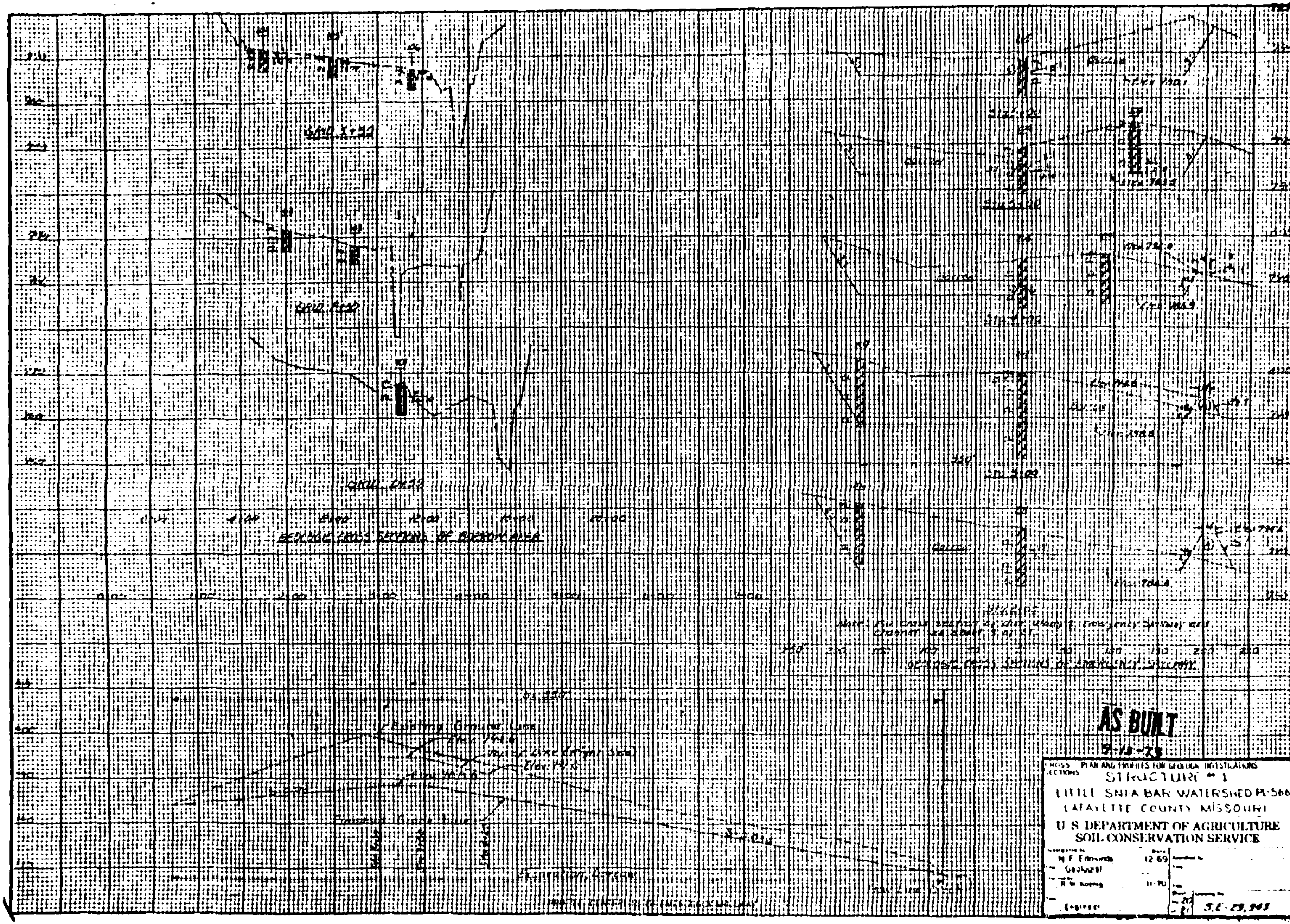


Note: The ends of the Stream Channel Excavation shall be 1:1 up to the existing groundline.

STRUCTURE NO 1
STREAM CHANNEL CROSS SECTIONS
LITTLE SNI-A-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

B.W.K. & G.K.M.	10-70	
M.D.H.	11-70	
D.E.S. & B.W.K.	11-70	5,E-29,943


GEOLOGIC CROSS SECTIONS OF BORROW AREA
GEOLOGIC CROSS SECTIONS OF EMERGENCY SPILLWAY
Existing Ground Line
Finished Grade Line
AS BUILT
CROSS SECTIONS PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
STRUCTURE # 1
LITTLE SNI A BAR WATERSHED PL-566
LAFAYETTE COUNTY MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
N. F. Edmonds
Geologist
12 69
11-70
5-E-29,945

STRUCTURE DATA

Class of Structure * "a" Floodwater Retarding
Drainage Area (total) 9,197 Ac. 14.37 Sq.Mi.
(uncontrolled) 9,197 Ac. 14.37 Sq.Mi.
Time of Concentration 2.3 Hours
Soil Cover Complex Number 78 For A.M.C. II
Sediment Capacity Available 651 Ac.Ft. below Elev. 774.0
Total Sediment Capacity Available 651 Ac.Ft.
Capacity Equivalents (Vol.) 0.85 In.
Retarding Capacity Provided 3,080 Ac.Ft.
Capacity Equivalents (Vol.) 4.02 In.
Water Supply Provided None Ac.Ft.-Identify Uses

Principal Spillway:
Maximum Capacity ~~(low stage)~~ 351 c.f.s.
~~Maximum Capacity (high stage) c.f.s.~~
10 Day Drawdown Elev. 774.0

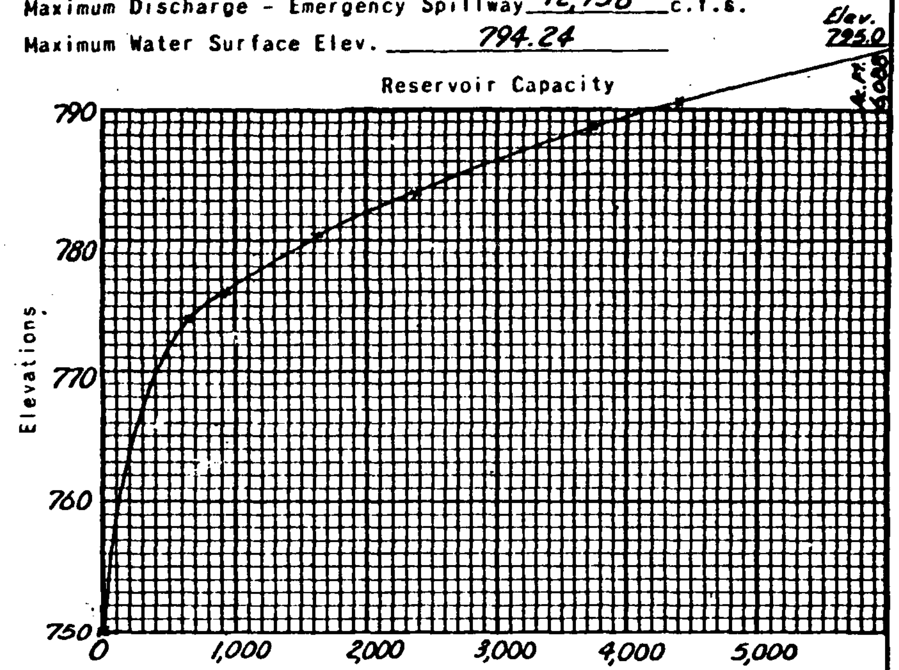
Emergency Spillway:
Percent Chance Use 2 Storm Duration 6 Hours
Type Vegetated Earth "n" Value Used 0.04

Emergency Spillway Hydrograph for Class * "a" Structures
Rainfall** 7.95 in.
Runoff 5.36 in.
Peak Inflow 13,865 c.f.s.
Maximum Discharge - Emergency Spillway 1,693 c.f.s.
Maximum Water Surface Elev. 790.36
Velocity of Flow (Ve) 5.9 f.p.s.
Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. = 774.0
Emergency Spillway Crest Elev. = 788.6
Emergency Spillway Bottom Width = 350'
Top of Settled Dam Elev. = 794.4
Height × Storage = 43.6 × 3,731 = 162,672

Freeboard Hydrograph for Class * "a" Structures
Rainfall** 13.67 in.
Runoff 10.80 in.
Peak Inflow 28,375 c.f.s.
Maximum Discharge - Emergency Spillway 12,758 c.f.s.
Maximum Water Surface Elev. 794.24

Reservoir Capacity



AS BUILT 9-13-73

Supplementary Data and Special Design Features:

*Class "b" hydrologic criteria used for design.

**Areal correction = 97% of Point Rainfall.
Emergency Point Rainfall = 8.2 inches
Freeboard Point Rainfall = 14.1 inches

STRUCTURE NO. 1
LITTLE SNI-A-BAR WATERSHED PL-566
LAFAYETTE COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	R.W.K. & G.K.M.	1970	Approved by
Drawn	B.E.S.	10-70	
Traced			
Checked	M.M.B. & R.W.K.	11-70	Sheet 1 of 1	Drawing No. 5,E-29,345-H

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory

800 "J" Street, Lincoln, Nebraska 68508

SUBJECT: ENG 22-5, Missouri WP-08, Little Sni-A-Bar Site No. 1 (Lafayette County)

DATE: September 18, 1970

TO: James M. Dale, State Conservation Engineer
SCS, Columbia, Missouri

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 5 sheets.
2. Form SCS-128 & 128A, Consolidation Test Data, 7 sheets (2 tests).
3. Form SCS-127, Soil Permeability, 2 sheets.
4. Form SCS-355A, Triaxial Shear Test Data, 3 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 11 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 4 sheets.

DISCUSSION

FOUNDATION

A. Bedrock. The bedrock underlying the site is shale and sandstone of the Kansas City Group, Missourian Series, of the Pennsylvanian System. The bedrock surface drops abruptly in the right abutment between test holes 10 and 11, which is a distance of 25 feet.

B. Classification. Soil cover over the left abutment is loess and ranges from 13 to 31 feet in thickness, and is field classified as CL with ML topsoil. Field samples of this material (Sample Nos. 4.2, 4.3, 4.4, and 4.5) from 13 feet through 24 feet are classified as CL's with liquid limits ranging from 33 to 43 and PI's ranging from 13 to 22. Field sample No. 4.1 from the 9-foot to 10-foot depth has a liquid limit of 50 and PI of 28 and is classified in the Laboratory as CL or CH. These samples are thought to be representative of the loess material on the left abutment and the right abutment to the right of the bedrock dropoff near Station 15+10.

The alluvium in the floodplain is reported to be uniform, and the upper 10 to 14 feet is classified as ML. This material was sampled in test hole 6, and Samples 6.1 and 6.2 have liquid limits of 26 and 27 with PI's of 3 and 5. They are classed as CL and CL-ML, respectively. In test hole 8, Samples 8.1 and 8.2 have liquid limits of 29 and 25 with PI's of 6 and 5, respectively. They are classed as ML and CL-ML, respectively.

Below the upper 10 to 14 feet and extending to bedrock the alluvium is field classified as very silty CL. In test hole No. 6, Samples 6.3 and 6.4 have liquid limits of 28 and PI's of 5, and are classed as ML. In test hole No. 8, Samples 8.3, 8.4, and 8.6 have liquid limits ranging from 30 to 34 with PI's ranging from 9 to 15, and are classed as CL.

A greenish gray, firm CL was reported above the bedrock on the left side of the valley. This material was sampled in test hole 5 by Sample 5.1. This sample has a liquid limit of 23 and PI of 4 and is classed CL-ML. Twenty-two percent of this material is sand size.

The alluvium is reported to become firmer near the abutments. Holes drilled 95 feet downstream from the centerline (TH's 601 through 606) indicate that old channel deposits are mixed with the alluvium in the valley section and directly overlie the bedrock in test holes 402 and 6.

C. Permeability. The geologist reports that no permeable materials were encountered at the site. Falling head permeability tests were made on Sample 70W1935 (Fld. No. 8.5) and Sample 70W1936 (Fld. No. 8.6). Sample 70W1935 is CL-ML material and has a permeability rate near 0.03 ft/day, and Sample 70W1936 is CL material and has a permeability rate near 0.002 ft/day.

D. Dry Unit Weight. The dry unit weight of Sample 70W1926 is 1.69 gm/cc. This sample represents the silty clay alluvium overlying the bedrock. The sample was taken from 18 to 19 feet in TH 5.

The dry density of Sample 70W1935 ranged from 1.43 gm/cc to 1.48 gm/cc. This sample was taken from 9 to 11 feet in TH 8 and represents the upper alluvium of the floodplain. Sample 70W1936 from 16 to 18 feet in TH 8 represents the silty clay overlying the bedrock and has a dry density of 1.54 gm/cc.

Blow count was also taken in TH 8 but the elevation of the water table in the hole was not recorded.

At 10 to 11 feet, N = 3; at 15 to 16 feet, N = 5; and at 20 to 21 feet, N = 5 was reported in the test hole logs.

Blow count was also taken in TH 6 and was recorded as N = 3 from 5 to 6 feet, N = 2 from 10 to 11 feet, N = 2 from 15 to 15.5 feet, N = 7 from 15.5 to 16 feet, and N = 7 from 18 to 19 feet.

E. Consolidation. Consolidation tests were made on Samples 70W1935 and 70W1936. The test specimens were flooded throughout the tests. At ℄ station 14+50 about 11 feet of the ML alluvium overlie 14 feet of the CL alluvium which rests on the bedrock. Settlement in the foundation was estimated on the basis of Sample 70W1935 representing the upper 11 feet of alluvium and on Sample 70W1936 representing the lower 13 feet of the alluvium. At the intersection of the dam ℄ and ℄ of the conduit, settlement in the range of 1.2 feet was computed. The fill is 29.1 feet in height at this location. At ℄ station 13+50 about 9 feet of the CL alluvium underlies the 47-foot embankment.

Settlement in the foundation alluvium was estimated on the basis of Sample 70W1936 representing this material, and settlement in the range of 0.58 foot was computed. At ℄ station 15+30 about 5 feet of ML underlie the 24-foot embankment. Settlement in the foundation alluvium was estimated on the basis of Sample 70W1935 being representative of the ML alluvium, and settlement in the range of 0.2 foot was computed.

F. Shear Strength. Consolidated undrained triaxial shear tests were made on Samples 70W1935 and 70W1936, which represent the ML alluvium and CL alluvium, respectively. In both tests, the test specimens were trimmed from the undisturbed sample. The test specimens of Sample 70W1935 were soaked prior to testing but the test specimens of Sample 70W1936 were tested at their natural water content. In both cases saturation of the test specimens was at least 95 percent of theoretical saturation. Shear strength parameters of $\phi = 25°$, c = 100 psf were interpreted for the ML alluvium represented by Sample 70W1935, and shear strength parameters of $\phi = 23°$, c = 150 psf were interpreted for the CL alluvium represented by Sample 70W1936.

EMBANKMENT

A. Classification. Emergency spillway samples 202.1 through 208.2 (Laboratory sample numbers 70W1940 through 70W1947) have liquid limits ranging from 43 to 33 and PI's ranging from 21 to 14. Borrow samples 101.1, 102.1 and 102.2 (Laboratory sample Nos. 70W1948, 70W1949, and 70W1950) are classified in the Laboratory as CL's. Borrow sample 105.1 (Laboratory No. 70W1951) has a liquid limit of 28 and PI of 6 and is classed as CL-ML. A detailed report of each sample's properties will be found in the attached Form SCS-354's.

B. Density. Standard Proctor compaction tests were made on 7 of the samples from the emergency spillway. Compacted dry density of these samples ranges from 103.0 pcf to 111.5 pcf and optimum moisture averages near 18 percent. Standard Proctor compaction tests were also made on the four borrow samples, and the compacted dry density of these samples ranges from 102.5 pcf to 108.5 pcf with optimum moisture averaging near 18 percent. See the attached Form SCS-354 for individual sample densities and optimum moisture contents.

C. Shear Strength. Sample 70W1941 from the emergency spillway is thought to be typical of the borrow materials at the site. A consolidated undrained triaxial shear test was made on this sample. The test specimens were molded near Proctor density and soaked prior to testing. At the time of testing the test specimens were near theoretical saturation, and shear strength parameters of $\phi = 12.5°$, c = 875 psf were interpreted from the test.

SLOPE STABILITY

A. Maximum Section at Station 12+00. At this location the embankment will be 50.6 feet in height, resting on 9 feet of alluvium over bedrock.

The analyses were made by a modification of the Swedish circle method and considered $2\frac{1}{2}$:1 upstream and downstream slopes, rapid drawdown from the base of the emergency spillway elevation to the base of the fill (full drawdown), full phreatic surface (no drain), and 10-foot wide berms on the upstream and downstream slopes. The embankment shear strength parameters are $\phi = 12.5°$, c = 875 psf, and both sets of shear strength parameters for the alluvial foundation were tried in the analyses. The weakest factor of safety found was 1.28 from an arc cutting through the embankment ($\phi = 12.5°$, c = 875 psf) upstream and 9 feet into the foundation with shear strength parameters of $\phi = 23°$, c = 150 psf.

B. Floodplain Section at Station 12+60. At this location the embankment will be 35.1 feet high resting on 22 feet of alluvial materials over the bedrock. The analyses consider the same conditions as the maximum section above. The weakest factor of safety of 1.39 was found in the upstream arc cutting through the embankment ($\phi = 12.5°$, c = 875 psf) and 22 feet into the alluvial foundation with shear strength parameters of $\phi = 25°$, c = 100 psf.

The stability analyses of both sections assume that depths of material shown on the centerline profile sheet 2 of 3 of Form SCS-35B for this site are level upstream and downstream. Because of the meander of the stream channel, the sections represented by the analyses are a little more severe than the conditions that exist in the field.

SETTLEMENT ANALYSIS

Settlement estimates made along the ℄ of the structure indicate settlement of 1.2 feet at Station 14+50, and settlement of 0.2 foot at Station 15+30. This is a differential of about 1 foot in a horizontal distance of 100 feet. The slope of the bedrock surface is quite steep here, and there is a possibility of tension cracks developing unless some corrective measures are taken.

RECOMMENDATIONS

A. Cutoff Trench. We concur with the trench depths and width recommended by the project engineer between ℄ stations 9+50 and 13+90. We suggest that the trench be deepened to the left of ℄ station 9+50 to about 5 feet to penetrate the zone of surface disturbances. To the right of ℄ station 13+90 differential cracking may be a problem, as previously discussed in the settlement analysis. To defend against this condition, we suggest that the trench be wider than normal from ℄ station 13+90 to the vicinity of ℄ station 15+30 in order to flatten the bedrock

through this area. Flattening the bedrock will insure better soil-to-bedrock contact and spread the load from the fill through this section. We suggest the trench be deepened to the right of ℄ station 15+30 to penetrate the zone of surface disturbances. The trench depths suggested should provide good cutoff of underseepage since the permeability of the alluvium under the trench is relatively low. We suggest the trench backfill and the material in the center section of the dam consist of the more plastic borrow materials to obtain the maximum deformability. Place the backfill at a minimum of 95 percent of standard Proctor density and control moisture at or wet of optimum.

B. Principal Spillway. At the proposed location (Station 14+50) the foundation consists of 24 feet of compressible alluvium assumed to be represented by Samples 70W1935 and 70W1936. Based on the consolidation tests of these samples, embankment height of 29.1 feet, and computed in accordance with TR 18 (Rev.), horizontal strain in the range of 0.011 ft/ft is expected at this location. At Station 13+90 (TH No. 8) the foundation depth is reduced to 22 feet of alluvium. Based on an embankment height of 33.1 feet, and the same consolidation tests, horizontal strain in the range of 0.009 ft/ft was computed at this location. We recommend that the conduit backfill be like that suggested for the cutoff trench. The cutoff trench suggested is quite deep and it may be necessary to deepen the conduit trench and to flare the side slopes of the cutoff trench in order to reduce the strain on the conduit. A ϕ angle of 30° is suggested for conduit loading computations.

C. Drain. Permeability of the foundation alluvial blanket over the bedrock is relatively low and a drain is not necessary for stability of the slopes. The soil blanket over the bedrock appears to be relatively thick in all areas except on the right abutment where it may thin over the bedrock ledge. It appears the suggested cutoff trench will be quite effective in all areas with the possible exception of the right abutment where drainage may be required. We suggest that the need for a drain be evaluated in the field. If a drain is used to provide a controlled outlet for the bedrock, the drain fill may consist of any uniformly graded sand-gravel mixture that contains less than 3-5 percent nonplastic fines.

D. Embankment Design.

1. Placement of Materials. A homogeneous embankment is suggested. However, we suggest that the borrow materials with higher PI's be placed in the center portion of the fill to improve embankment deformability and lower the possibility of tension drying cracks. We recommend placing the embankment at a minimum of 95 percent of standard Proctor density with placement moisture controlled at or wet of optimum.

2. Slopes. The slope stability analyses indicate that the proposed $2\frac{1}{2}$:1 upstream and downstream slopes with 10-foot berms have acceptable factors of safety.

3. Settlement. An overfill allowance of 1.6 feet is suggested to compensate for residual settlement within the fill and foundation.

Prepared by:
Gerald N. Gibson
Gerald N. Gibson

Reviewed and Approved by:
Lorn P. Dunnigan
Lorn P. Dunnigan
Head
Soil Mechanics Laboratory

Attachments

cc:
James M. Dale (1)
Gerald K. McElhiney, Higginsville, Mo.
E. D. Butler, Lincoln, Nebraska

5/14/70

Ht. = 49'
97,715 cu yd

Class "a"
Floodwater

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

MISSOURI

Little Sni-A-bar Site: 1

Laboratory Sample Number	Field Number	Location and Description			Depth	Field Classification	Fines .002	Fines .005	Fines .02	Fines .05	Fines #200	Sand #140	Sand #60	Sand #40	Sand #20	Sand #10	Sand #4	Gravel 3/8"	Gravel 1/2"	Gravel 3/4"	Gravel 1"	Gravel 1 1/2"	Gravel 3"	Atterberg LL	Atterberg PI	Unified Classification	Soluble Salts %	Dispersion %	In-place γd	In-place %
70W																														
1921	4.1	¢ Dam	8+90	S. Bag	9-10'	CL	38	53	79	100														50	28	CL				122
1922	4.2	"	"	S. Bag	13-14'	CL	27	33	62	13	100													41	19	CL				122
1923	4.3	"	"	S. Bag	16-17'	CL	24	31	60	96	100													39	13	CL				124
1924	4.4	"	"	S. Bag	18-19'	CL	26	33	61	15	100													43	22	CL				[illegible]
1925	4.5	"	"	S. Bag	23-24'	CL	22	27	55	92	100													33	13	CL				155
1926	5.1	¢ Dam 10' L	10+40	Undist.	18-19'	CL	16	19	35	64	78					100								23	4	CL-ML			109	[illegible]
1927	6.1	¢ Dam 25' L	11+10	Jar	5-6'	ML	16	21	42	36	95					100								26	3	ML				[illegible]
1928	6.2	"	"	Jar	10-11'	ML	15	20	40	84	95					100								27	5	CL-ML				[illegible]
1929	6.3	"	"	Jar	15-16'	CL	15	19	37	59	[illegible]	72	83	87	[illegible]	[illegible]	96	99	100					25	5	ML				[illegible]

5/14/70

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Laboratory Sample Number	Field Number	Location and Description		Depth	Field Classification	Fines .002 mm	.005	.02	.05	#200 .074	Sand #140	#60	#40	#20	#10	#4	Gravel 3/8"	1/2"	3/4"	1"	1 1/2"	3"	LL	PI	Unified Classification	Soluble Salts %	Dispersion %	Moisture-Density Max γ_d pcf	w_o %	Undisturbed γ_d g/cc	w_n %	G_s	Special Tests	
70W		MISSOURI Little Sni-A-bar Site: 1																																
1930	6.4	℄ Dam 25' L, 11+10	Jar	18-19'	CL	13	24	45	84	94					100								23	5	ML						16.7			
1931	8.1	℄ Dam 13+90	S. Bag	5-6'	ML	16	21	43	84	95					100								29	6	ML						4.3			
1932	8.2	" "	S. Bag	10-11'	ML	15	18	37	70	83					100								25	5	CL-ML						13.6			
1933	8.3	" "	S. Bag	15-16'	CL	18	25	47	85	95					100								30	9	CL						12.9			
1934	8.4	" "	S. Bag	20-21'	CL	23	30	53	77	91					100								32	15	CL						17.[illegible]			
1935	8.5	" 14+00	Undist.	9-11'	ML	14	19	36	73	89	96	100											27	6	CL-ML					[illegible]	22.[illegible]	[illegible]	✓	✓
1936	8.6	" "	Undist.	16-18'	CL	16	23	49	83	94					100								30	10	CL					[illegible]	25.[illegible]	[illegible]	✓	✓
1937	604.1	℄ Dam 90' L, 12+60	S. Bag	7-9'	ML	16	17	36	72	86	87	95	97	99	100								23	6	CL-ML									

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

5/14/70

MISSOURI

Little Sni-A-bar Site: 1

Lab. Sample Number	Field Number	Location and Description	Depth	Field Classification	Fines 0.002 mm	0.005	0.02	0.05	#200 0.074	Sand #140	#60	#40	#20	#10	#4	Gravel 3/8"	1/2"	3/4"	1"	1 1/2"	3"	Atterberg Limits LL	PI	Unified Classification	Soluble Salts %	Dispersion %	Moisture-Density Test No.	Max γ_d pcf	w_o %	Undisturbed Sample Data γ_d g/cc	w_o %	G_s	Special Tests
70W																																	
1944	206.2	¢ Emer. Spwy. 175' L 2+00 L. Bag	6-10	CL	24	30	61	95	100													32	15	CL			5)	124.5	12.2			[illegible]	
1945	206.3	" " L. Bag	10-13'	CL	26	31	56	88	98					100								33	15	CL									
1946	208.1	¢ Emer. Spwy. 90' R 4+00 L. Bag	1-6'	CL	29	33	62	93	100													42	21	CL			(1)	[illegible]	12.5			[illegible]	
1947	208.2	" " L. Bag	6-11'	CL	24	28	59	94	100													37	15	CL			2)	125.5	12.2			2.7[illegible]	
1948	101.1	Borrow, D+50 11+05 L. Bag	1-5'	ML	22	26	55	93	100													31	10	CL			(3)	123.5	16.5			[illegible]	
[illegible]	102.1	Borrow, F+50 6+00 L. Bag	2-3'	ML	33	39	[illegible]	95	100													45	25	CL			(1)	[illegible]	[illegible]			[illegible]	

Form SCS-354
5/14/70

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Laboratory sample number	Field number	Location and description	Depth	Field classification	Fines .002 mm	Fines .005	Fines .02	Fines .05	Fines #200 .074	Sand #100	Sand #60	Sand #40	Sand #20	Sand #10	Sand #4	Gravel 3/8"	Gravel 1/2"	Gravel 3/4"	Gravel 1"	Gravel 1 1/2"	Gravel 3"	Atterberg limits LL	Atterberg limits PI	Unified classification	Soluble salts %	Dispersion %	Moisture-density Test no.	Max γ_d pcf	w_o %	Undisturbed γ_d g/cc	Undisturbed w_o %	G_s	Special tests
70W		MISSOURI Little Sni-A-Bar Site: 1																															
1950	102.2	Borrow F+50, 6+00 L. Bag	3-5'	CL	13	26	61	94	73					100								30	10	CL			10	122.0	13.0			2.69	
1951	105.1	Borrow, I+50 8+00 L. Bag	0-1'	ML	13	21	52	95	100													23	6	CL-ML			11	122.5	12.5			2.6[illegible]	

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE	SAMPLE LOCATION
[illegible] MISSOURI	℄ DAM 14+00

FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN
[illegible]	9.0'-11.0'	Alluvium

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SCS-LINCOLN	G. N. G.	8-20-70

CLASSIFICATION [illegible]

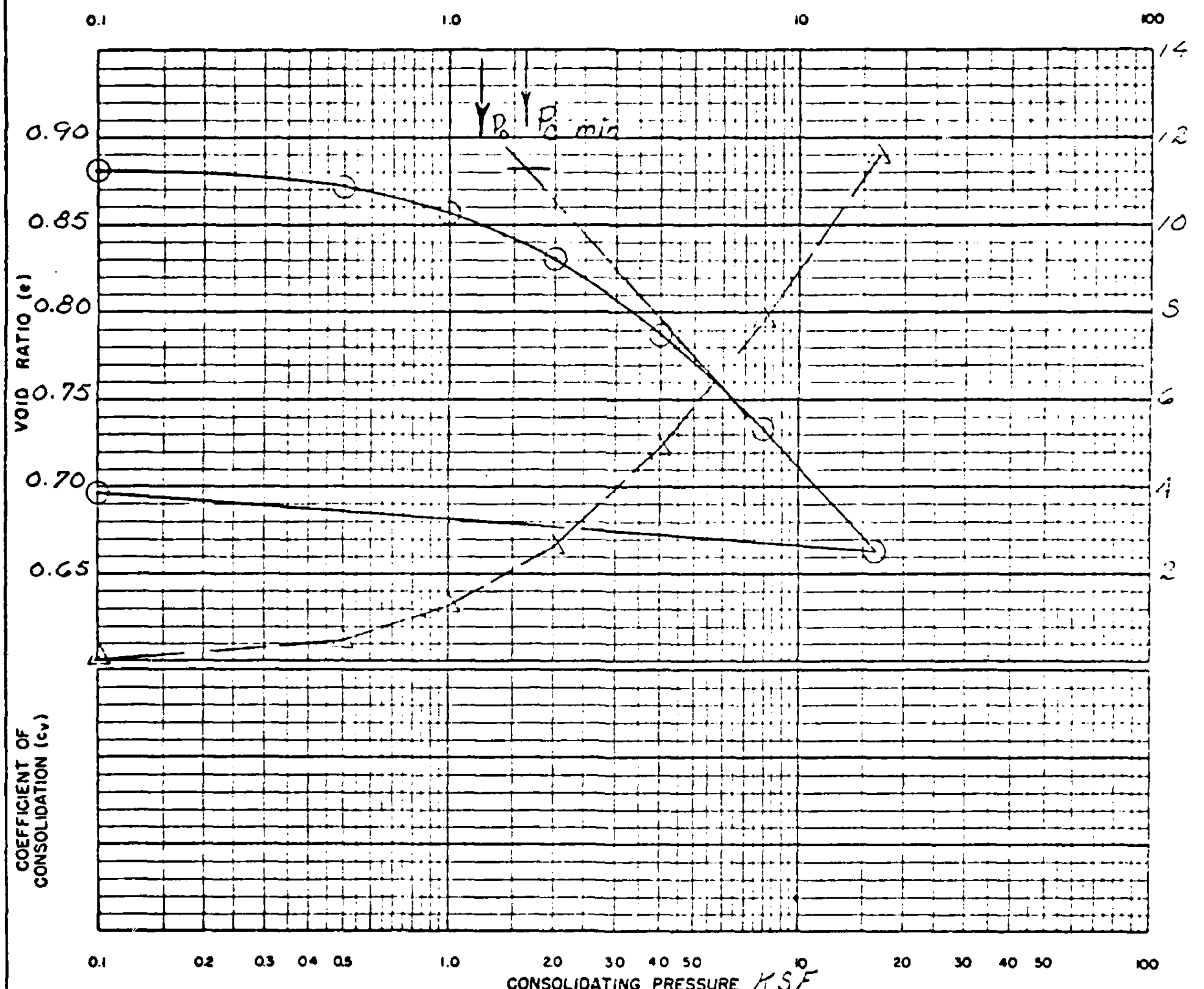
G_s [illegible] LL [illegible] PI 6

INITIAL DENSITY γ_d [illegible]

INITIAL VOID RATIO, e_0 [illegible]

COMPRESSION INDEX, C_c 0.215

TEST SPECIFICATIONS:
Saturated at Start



REMARKS Appears to be normally consolidated.

9-64

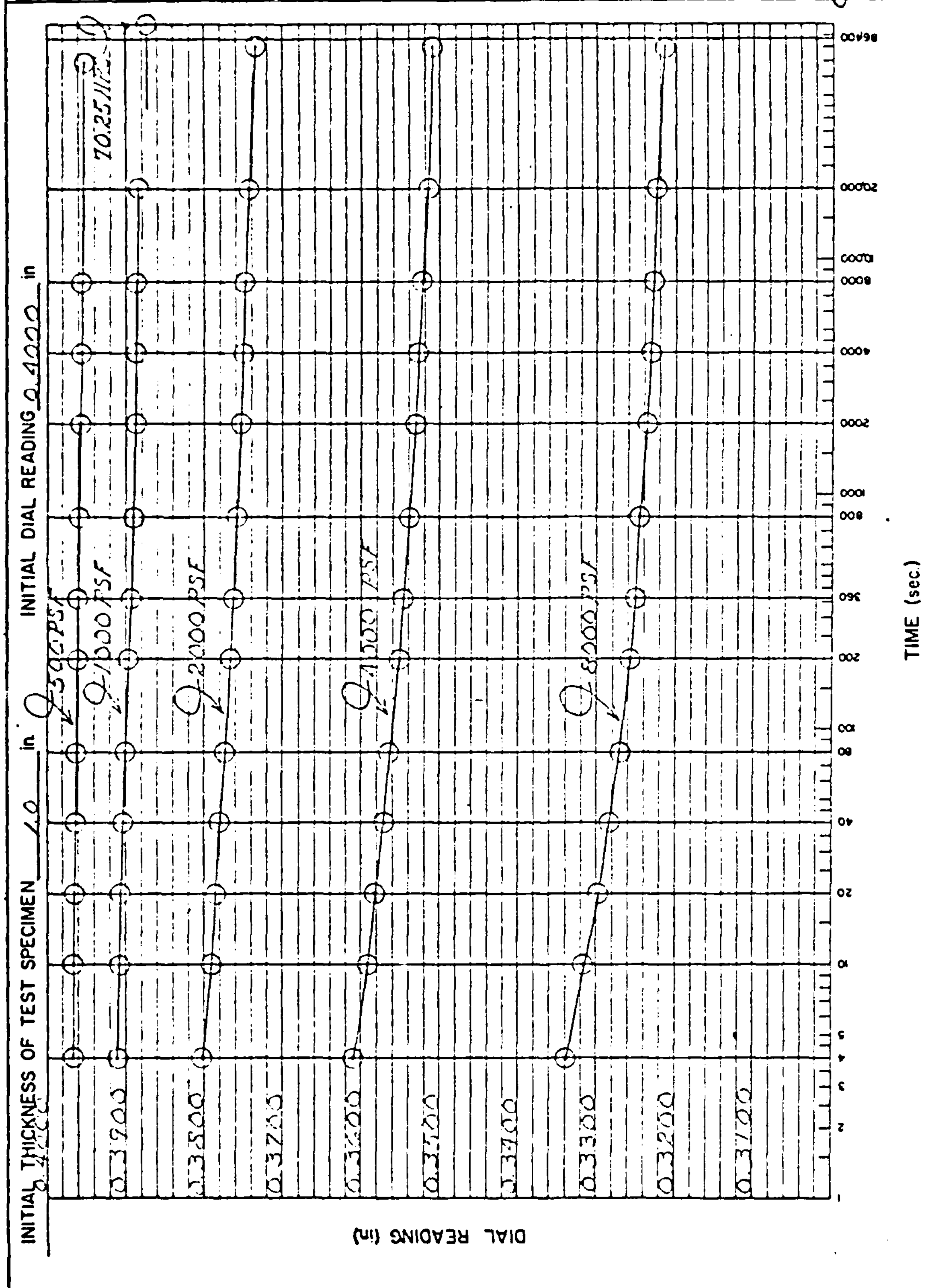
LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE	SAMPLE LOCATION
[illegible] MISSOURI	[illegible]

FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN
[illegible]	[illegible]	Alluvium

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SNL-LINCOLN	G. N. G.	8-20-70



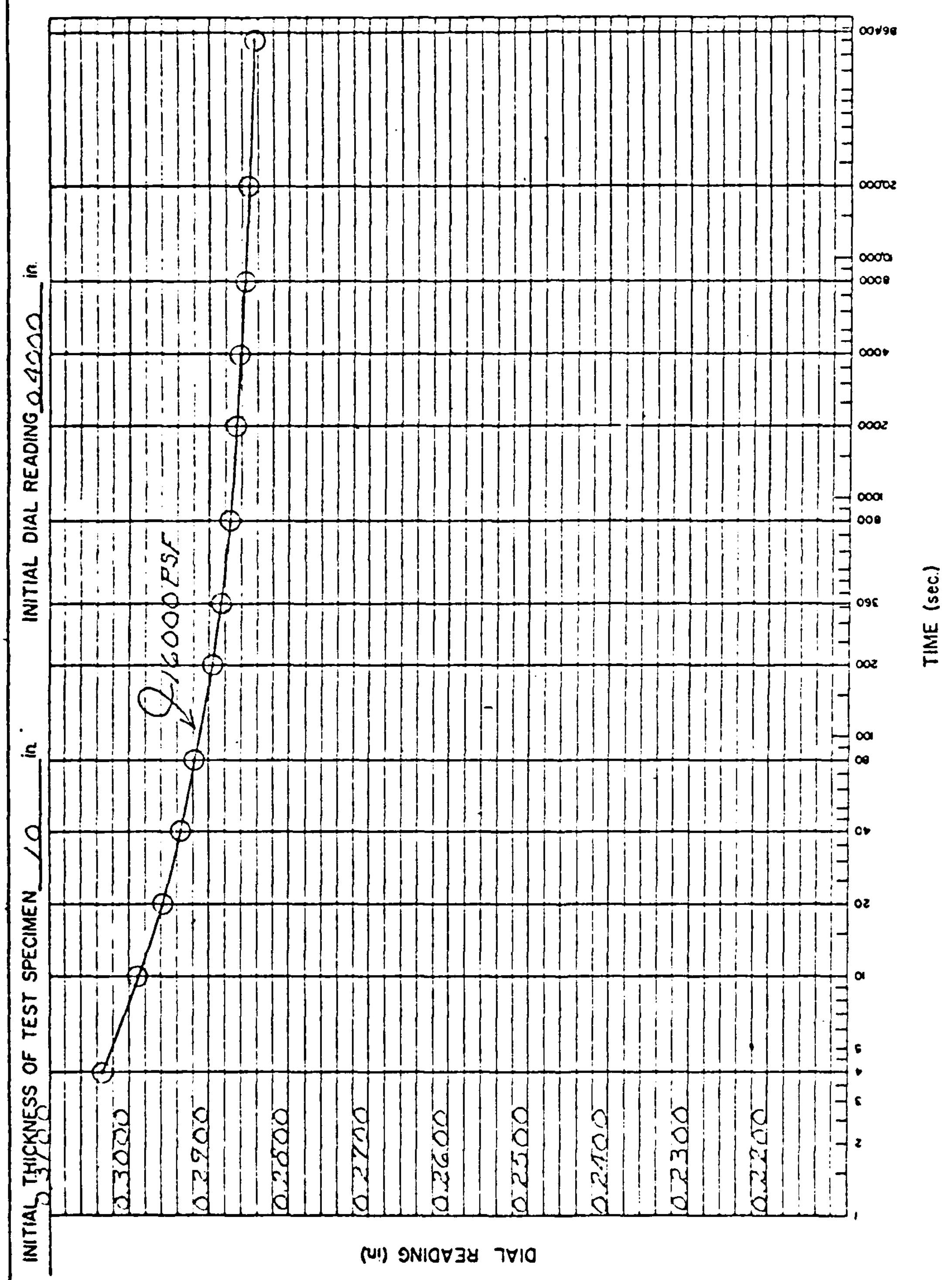
REMARKS

Form SCS-129A
9-64

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
LITTLE SNI-A-BAR NO 1 MISSOURI			C DAM 6+00
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
8-2	9.5'-11.0'	Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SCS-LINCOLN	G. N. G.	8-20-70



REMARKS

Form SCS-128
9-64

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE	SAMPLE LOCATION
[illegible] SYCAMORE [illegible] MISSOURI	[illegible]

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
[illegible]	10.0'-15.0'	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SML-LINCOLN		

CLASSIFICATION CL

G_s [illegible] LL 30 PI 10

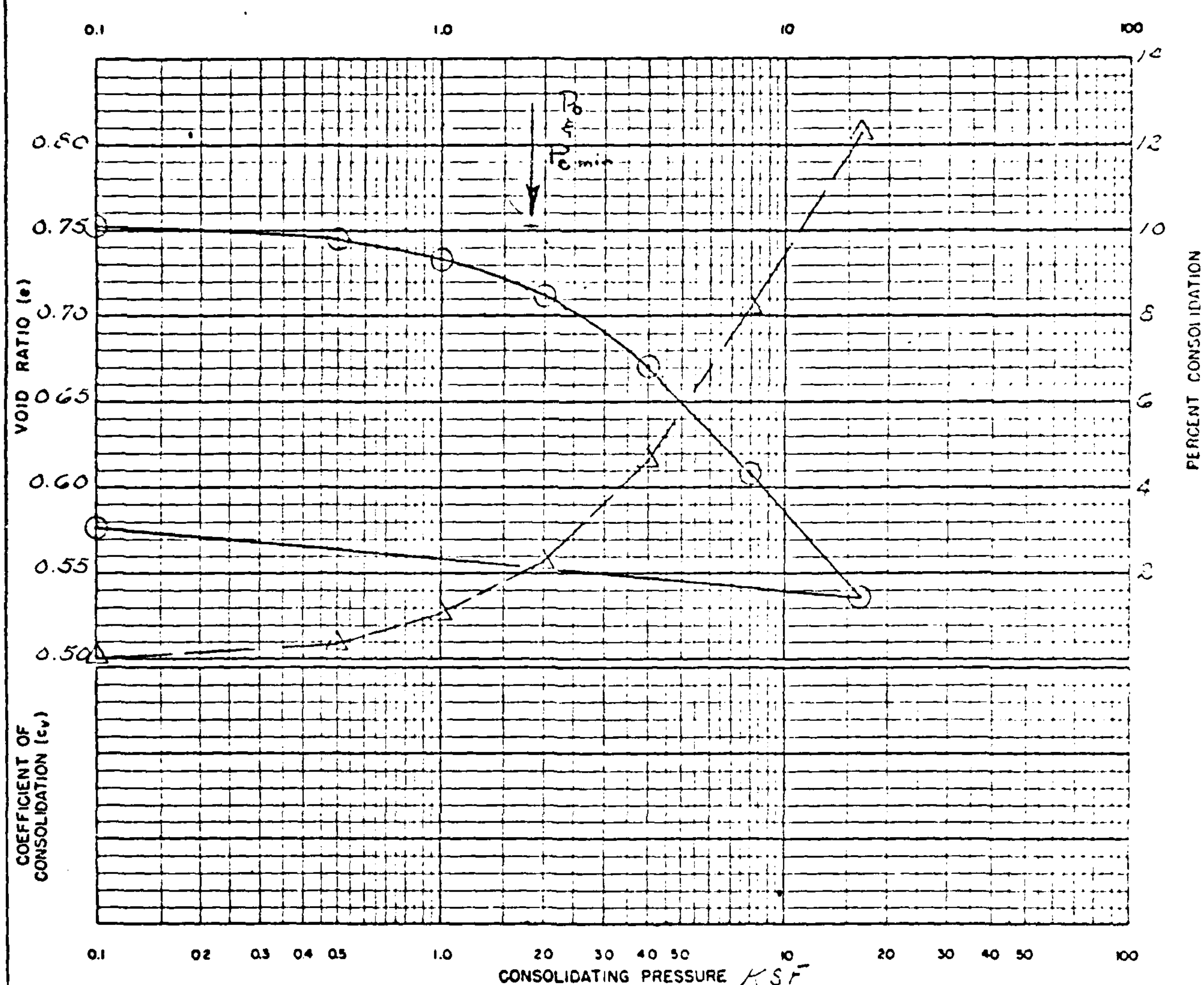
INITIAL DENSITY γ_d [illegible]

INITIAL VOID RATIO, e_0 [illegible]

COMPRESSION INDEX, C_c 0.326

TEST SPECIFICATIONS:

Saturated at Start



REMARKS Appears to be normally consolidated.

Form SCS-128A
9-64

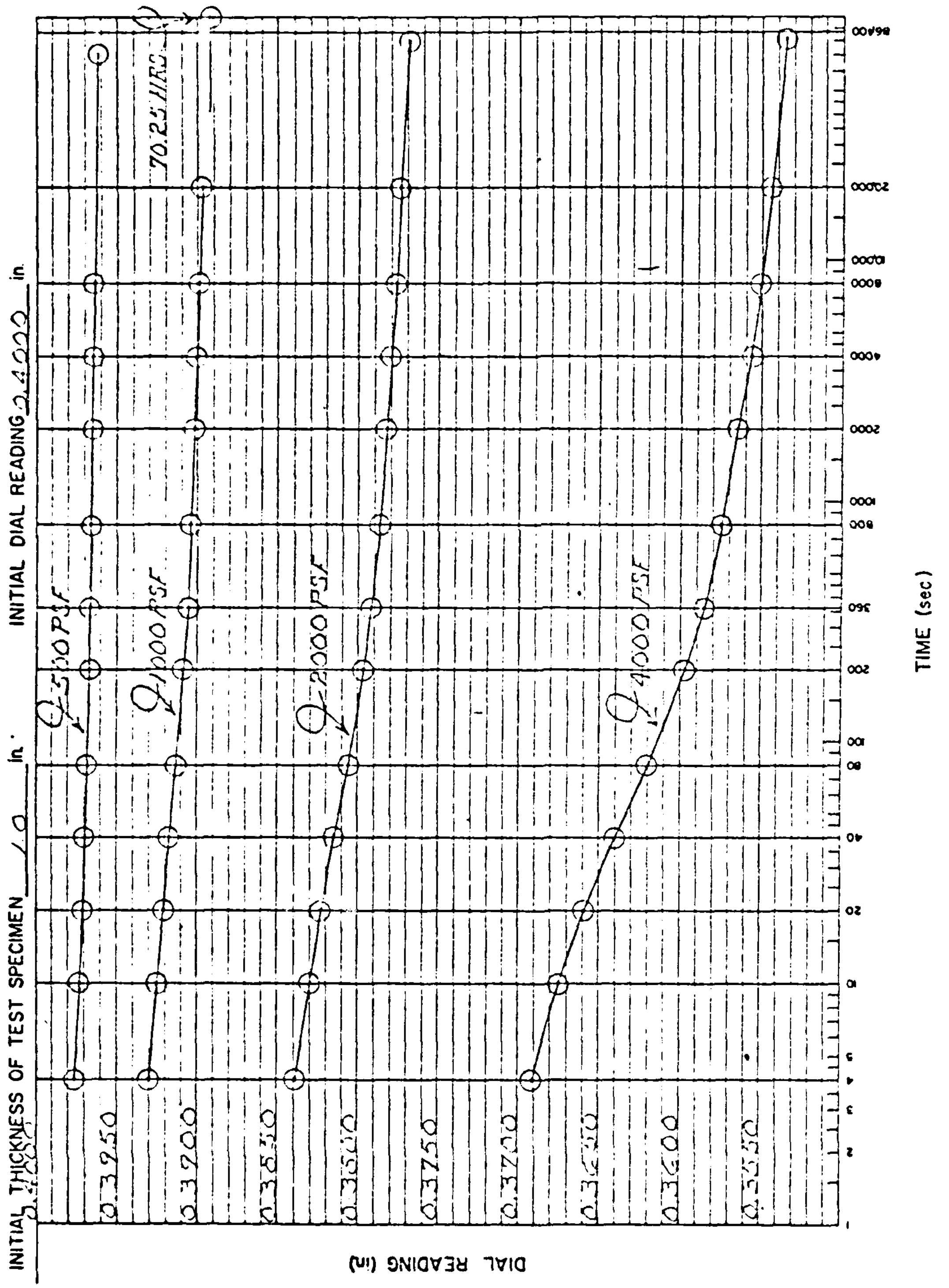
LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE	SAMPLE LOCATION
LITTLE SNI-A-BAR ... MISSOURI	Ⓒ DAM 14+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
E6	16.0'-18.0'	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SML-LINCOLN		



REMARKS

9-64

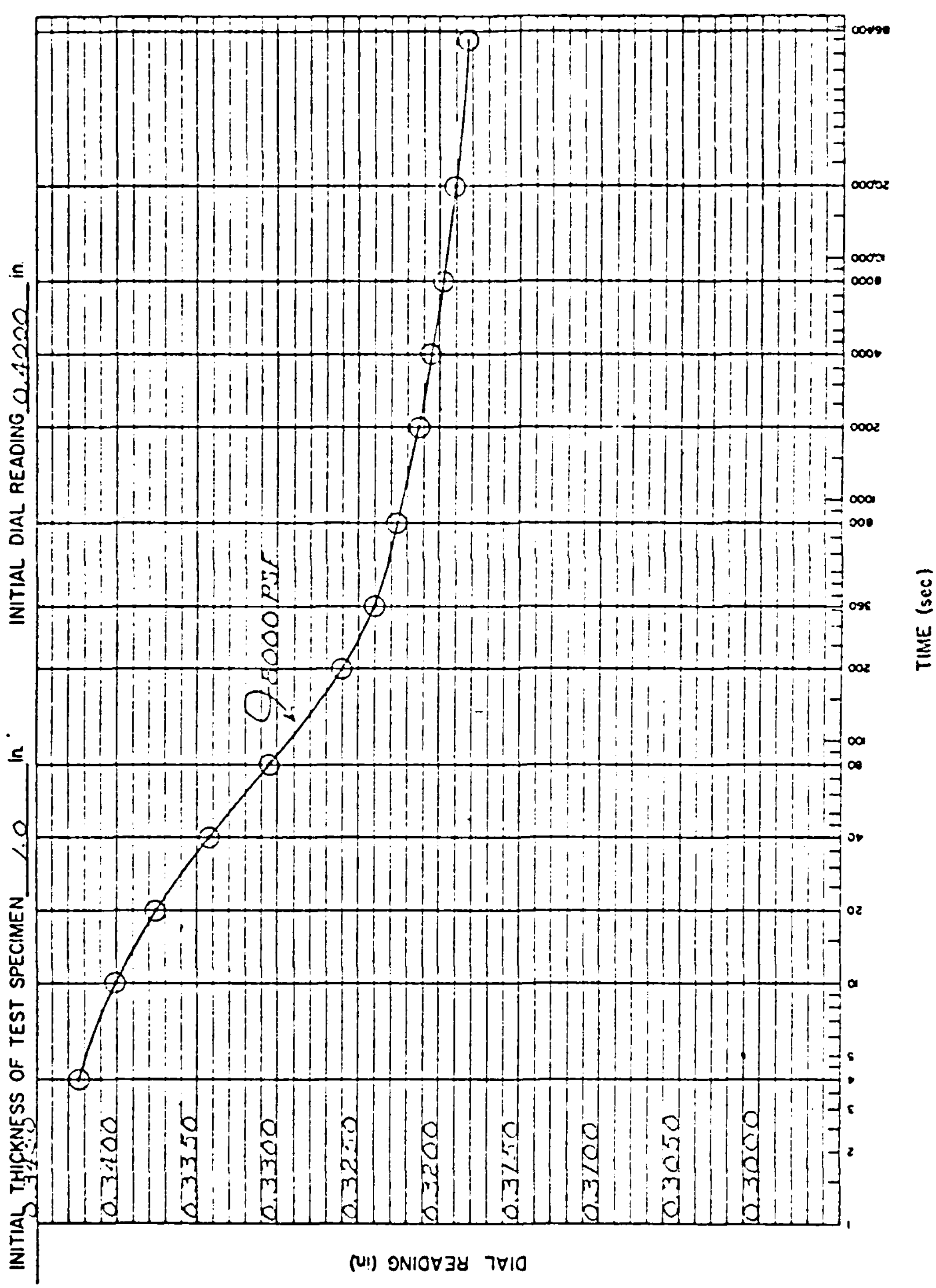
LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE	SAMPLE LOCATION
LITTLE SNI-A-BAR NO 1 MISSOURI	℄ DAM 14+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
S-1	12.0'-16.0'	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SML-LINCOLN		



REMARKS

9-64

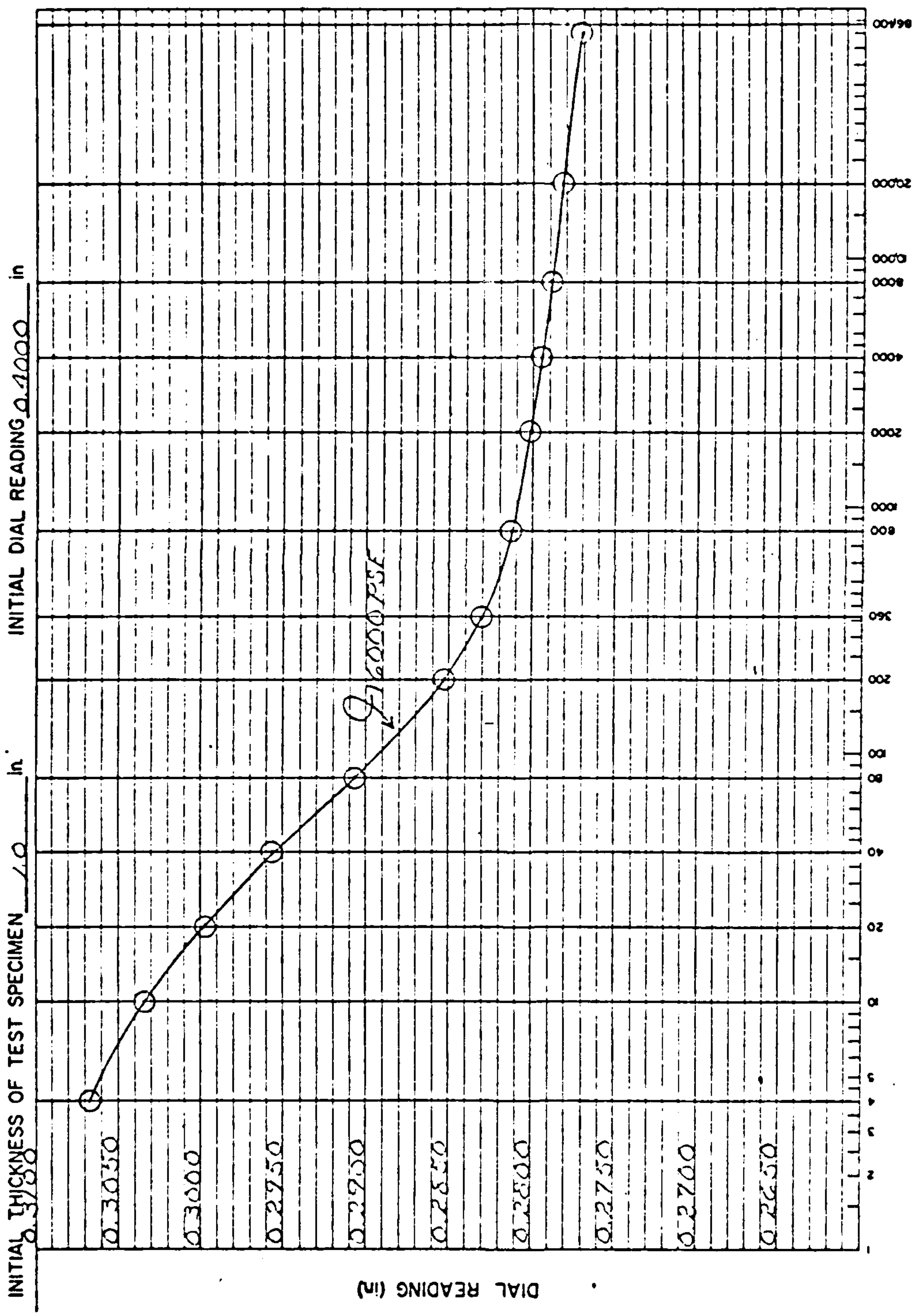
LABORATORY NO 70WL1234

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE	SAMPLE LOCATION
LITTLE SNI-A-BAR NO. 1 MISSOURI	℄ DAM 14+00

FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN
E-6	6.0'-15.0'	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
UNDISTURBED	SNTL-LINCOLN		



REMARKS

Form SCS 27
9-64

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: [illegible] SW-A-[illegible] No. 1 Missouri		SAMPLE LOCATION: [illegible] DAM 14+00
FIELD SAMPLE NO: [illegible]	DEPTH: 90'-110'	GEOLOGIC ORIGIN: Alluvium
TYPE OF SAMPLE: Undisturbed	TESTED AT: SAIL-Lincoln	APPROVED BY: G. N. B. / DATE: 8-20-70

CLASSIFICATION CL-ML

LL 27 PI 6

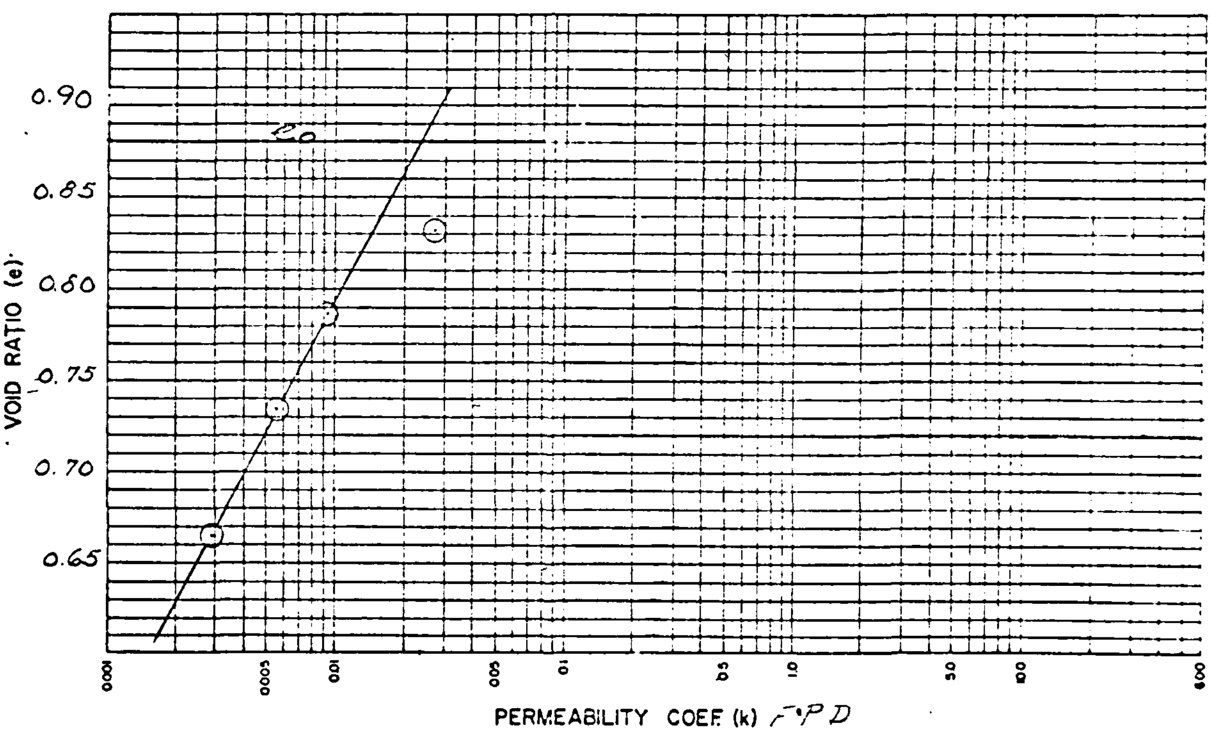
TEST NO.	1 2000	2 4000	3 8000	4 16000
INITIAL MOISTURE %				
DRY DENSITY ☑ g/cc ☐ pcf	1.46	1.49	1.54	1.60
VOID RATIO	0.8310	0.7579	0.7328	[illegible]
PERMEABILITY COEF FPD	0.027	0.0093	0.0055	0.0029
PERCOLATION COEF				
H/L DURING TEST				

SPECIFIC GRAVITY

G_s (-) #4	2.67
G_s (+) #4	
G_m(Bulk)(+) #4	

TEST SPECIFICATIONS

Falling Head Perm Test on the Consolidation Sample



REMARKS

K ≈ 0.03 ft/day

Form SCS 27
9-64

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE			SAMPLE LOCATION
Little Sni-A-Bar No. 1 Missouri			[illegible]
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]	Allluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	SML-Lincoln	G. N. G.	8-20-70

CLASSIFICATION CL

LL 30 PI 10

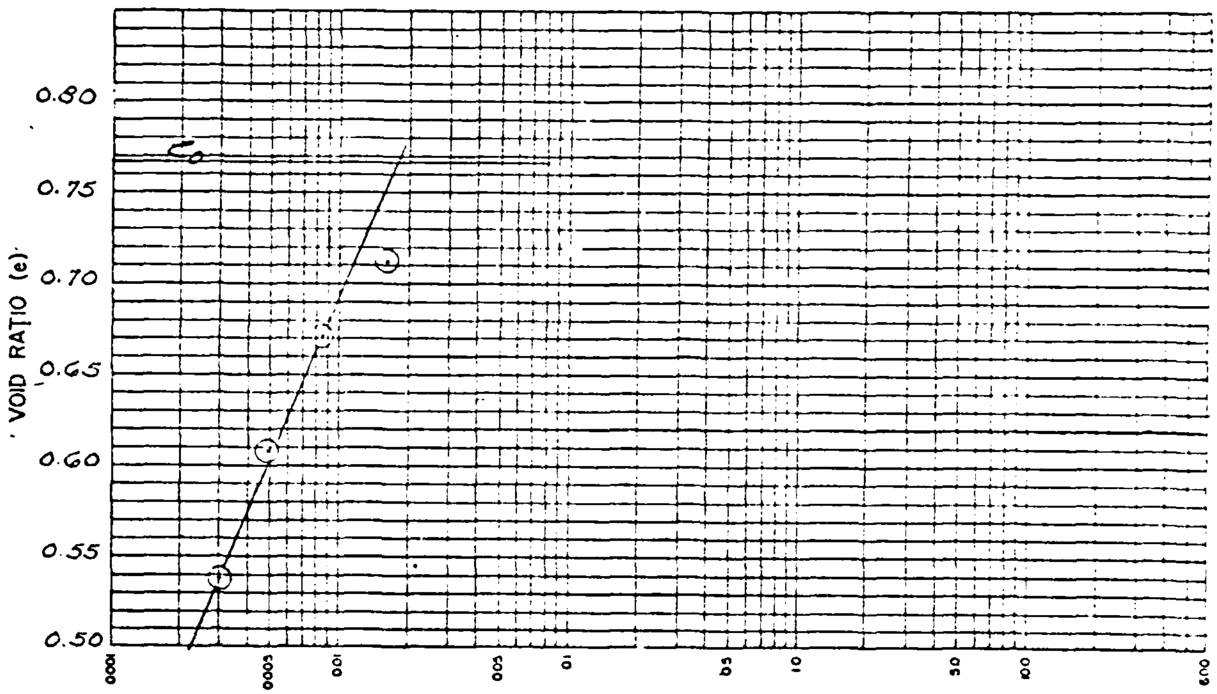
TEST NO.	1 2000	2 4000	3 8000	4 16000
INITIAL MOISTURE %				
DRY DENSITY ☒ g/cc ☐ pcf	1.57	1.60	1.67	1.74
VOID RATIO	0.7112	0.6702	0.6063	0.5383
PERMEABILITY COEF. FPD	0.0016	0.00055	0.00049	0.00030
PERCOLATION COEF				
H/L DURING TEST				

SPECIFIC GRAVITY

G_s (-) #4	2.65
G_s (+) #4	
G_m(Bulk)(+) #4	

TEST SPECIFICATIONS

Falling Head Perm Test on The Consolidation Sample



REMARKS

$K \approx 0.002$ ft/day

Form SCS 355A
Rev 6-65

LABORATORY NO 7011925

MATERIALS TESTING REPORT | U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE | TRIAXIAL SHEAR TEST

PROJECT and STATE		SAMPLE LOCATION
Little Sni-A-Bar Site: 1 Missouri		℄ Dam 14+50

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
6.5	9-11'	Alluvium

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	SNL-Lincoln	G. N. G	8-20-70

INDEX TEST DATA

USCS CL-ML; LL 27; PI 6

% FINER (mm): 0.002 14; 0.005 19; 0.074 (#200) 89

G_s (-#4) 2.67; G_s (+#4) ____

STANDARD: γ_d MAX. ____ pcf; w_o ____ %

MODIFIED: γ_d MAX. ____ pcf; w_o ____ %

SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION TRIMMED FROM AN UNDISTURBED CORE

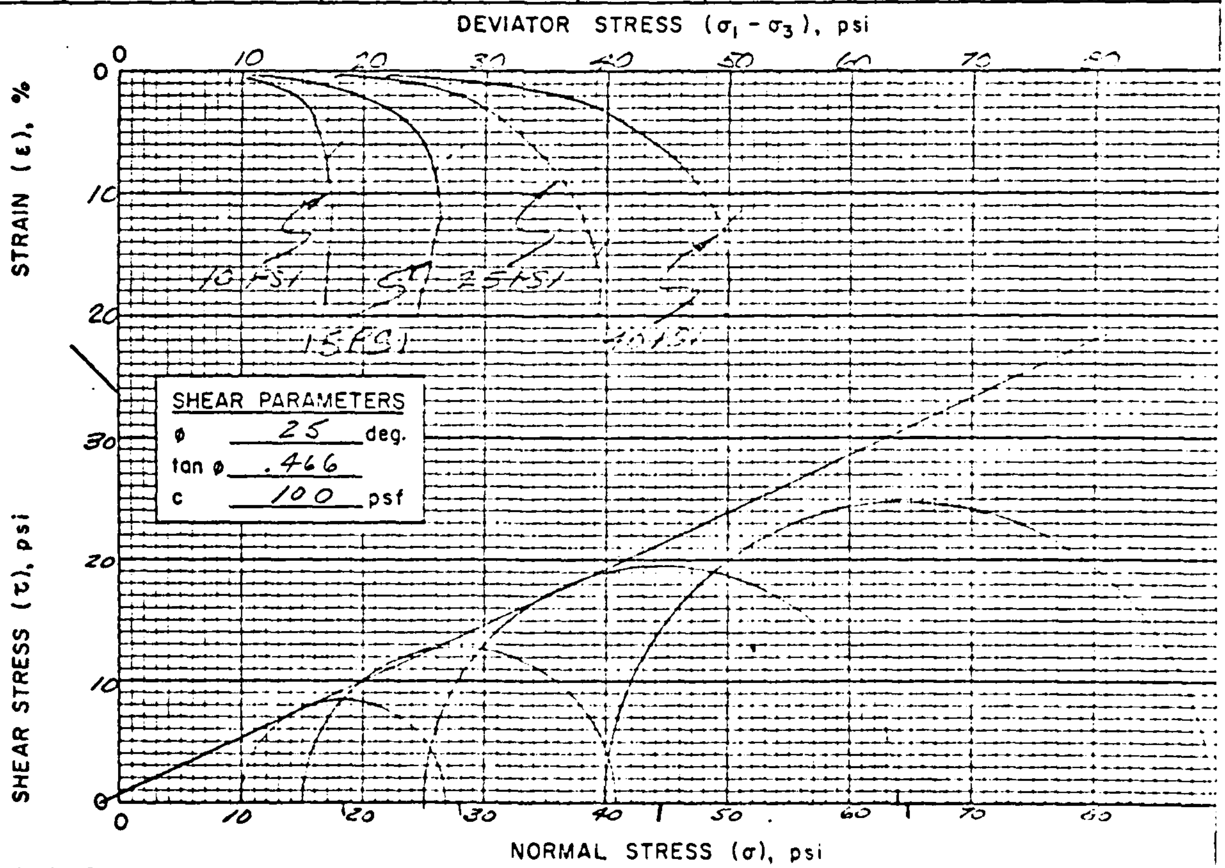
MOLDING MOISTURE ____ %

MOLDED AT ____ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY INITIAL pcf ☐ g/cc ☑	DRY DENSITY CONSOLIDATED pcf ☐ g/cc ☑		MOISTURE CONTENT, % START OF TEST	DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, % END OF TEST	TIME OF CONSOLIDATION (hrs)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
1.44	1.45		30.4	75.0	28.1	4.63	10	16.8	7.0
1.47	1.54		29.4	96.1	26.4	5.32	15	25.7	8.0
1.48	1.57		30.3	100.0	26.5	4.63	25	38.9	15.0
1.48	1.60		29.7	78.9	24.8	4.72	40	49.5	13.0



REMARKS SOAKED TO SATURATE

Form SCS 355A
Rev 6-65

LABORATORY NO. 70W1193[illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: Little Sni-A-Bar Site: 1 Missouri

SAMPLE LOCATION: ℄ Dam 15+90

FIELD SAMPLE NO.: 8.6

DEPTH: 13-18'

GEOLOGIC ORIGIN: Alluvium

TYPE OF SAMPLE: Undisturbed

TESTED AT: SML - Lincoln

APPROVED BY: [illegible]

DATE: 8-20-70

INDEX TEST DATA

USCS CL; LL 30; PI 10

% FINER (mm): 0.002 15; 0.005 25;
0.074 (#200) 94

G_s (-#4) 2.65; G_s (+#4) ______

STANDARD: γ_d MAX. ______ pcf; w_o ______ %

MODIFIED: γ_d MAX. ______ pcf; w_o ______ %

SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION TRIMMED FROM AN UNDISTURBED CORE

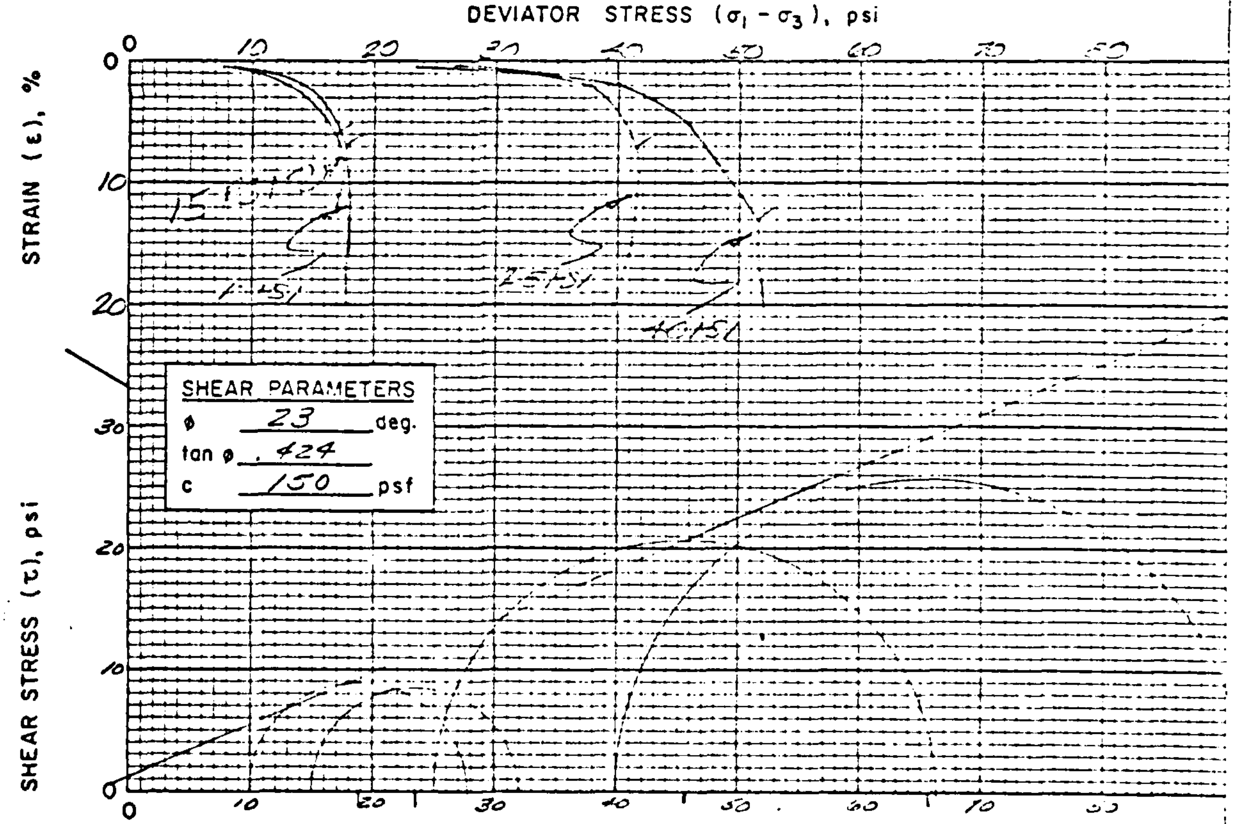
MOLDING MOISTURE ______ %

MOLDED AT ______ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY: INITIAL pcf ☐ g/cc ☑	DRY DENSITY: CONSOLIDATED pcf ☐ g/cc ☑		MOISTURE CONTENT, %: START OF TEST	DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, %: END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
1.517	1.520		27.5	96.3	27.4	6.50	10	17.7	7.0
1.49	1.55		25.7	96.3	27.5	5.18	15	16.9	6.0
1.52	1.53		28.1	99.6	27.6	6.30	25	41.3	7.0
1.53	1.58		28.0	100.0	26.0	6.38	40	51.5	13.0



SHEAR PARAMETERS

ϕ 23 deg.

tan ϕ .424

c 150 psf

REMARKS TESTED AT NATURAL H_2O

[illegible]

Form SCS 355 A
Rev 6-65

LABORATORY NO 70-11192

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: LITTLE SNI-A-BAR SITE: 1 MISSOURI
SAMPLE LOCATION: ℄ EMER. SPWY. 3+00

FIELD SAMPLE NO.: 202.2
DEPTH: 5-10'
GEOLOGIC ORIGIN: LOESS

TYPE OF SAMPLE: COMPACTED
TESTED AT: SML-LINCOLN
APPROVED BY: D. N. G.
DATE: 8-20-70

INDEX TEST DATA

USCS CL; LL 39; PI 16
% FINER (mm): 0.002 24; 0.005 25;
0.074 (#200) 95
G_s (-#4) 2.69; G_s (+#4) ____
STANDARD: γ_d MAX. 103.0 pcf; w_o 19.0 %
MODIFIED: γ_d MAX. ____ pcf; w_o ____ %

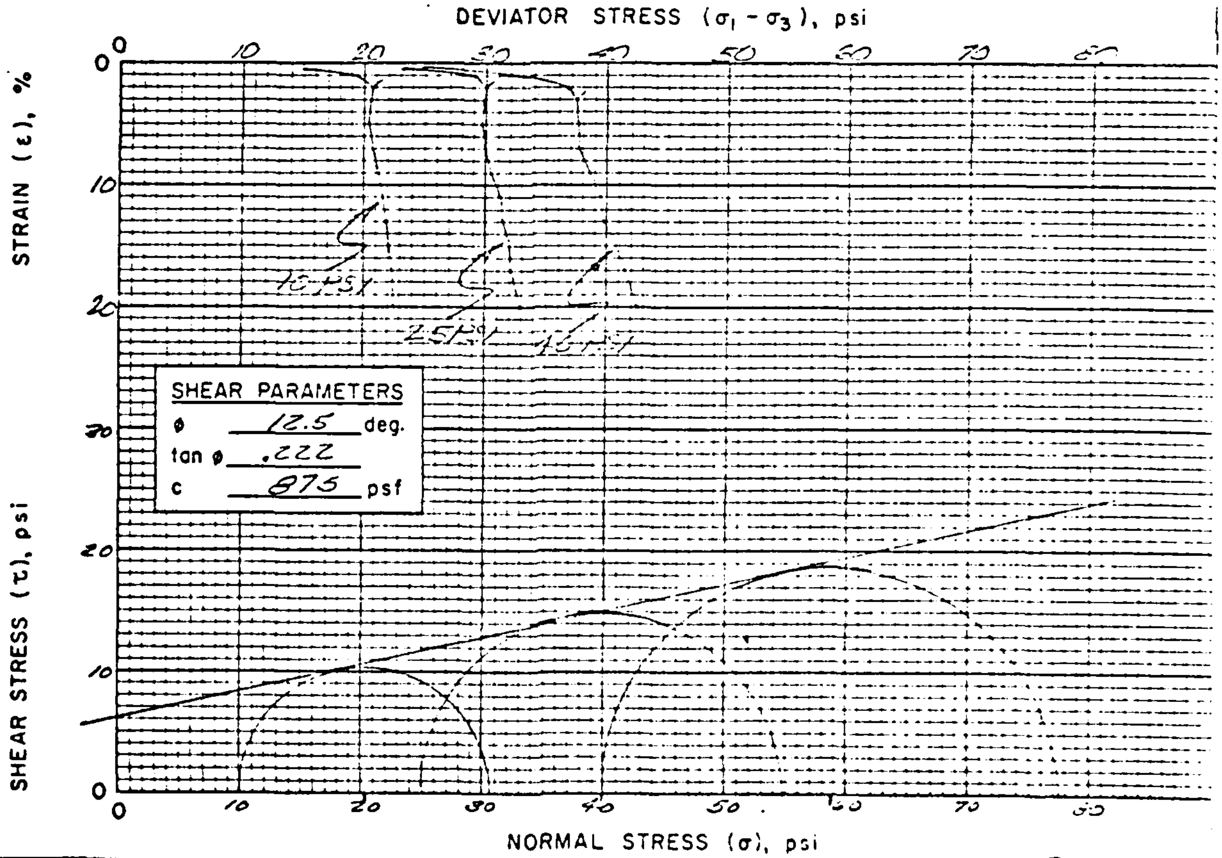
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION STATIC 3 LAYER COMPACTION & SOAKED
MOLDING MOISTURE 20.9 %
MOLDED AT 94.3% OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY: INITIAL pcf ☒ g/cc ☐	DRY DENSITY: CONSOLIDATED pcf ☒ g/cc ☐		MOISTURE CONTENT, %: START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
96.5	97.3		26.2	96.3	25.7	15.98	10	20.6	2.0
96.7	99.0		26.1	96.0	24.6	16.17	25	29.9	2.0
96.5	100.2		26.3	96.7	23.8	16.10	40	37.4	3.0



SHEAR PARAMETERS
φ 12.5 deg.
tan φ .222
c 875 psf

REMARKS AVERAGE TEST γ_d = 93.8 % STD

GTH / DAS

USDA SCS HYATTSVILLE MD 1966

Form SCS 352
Rev. 5-65

LABORATORY NO. 70W 1940

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 MISSOURI

FIELD SAMPLE NO: 302.1 | LOCATION: E Emer. Spwy. 3+00 | DEPTH: 1.0-5.0'

GEOLOGIC ORIGIN: LOESS | TESTED AT: SML-LINCOLN | APPROVED BY: G.N.G. | DATE: 8-20-70

CLASSIFICATION CL LL 43 PI 21

MAX. PARTICLE SIZE INCLUDED IN TEST <#4 "

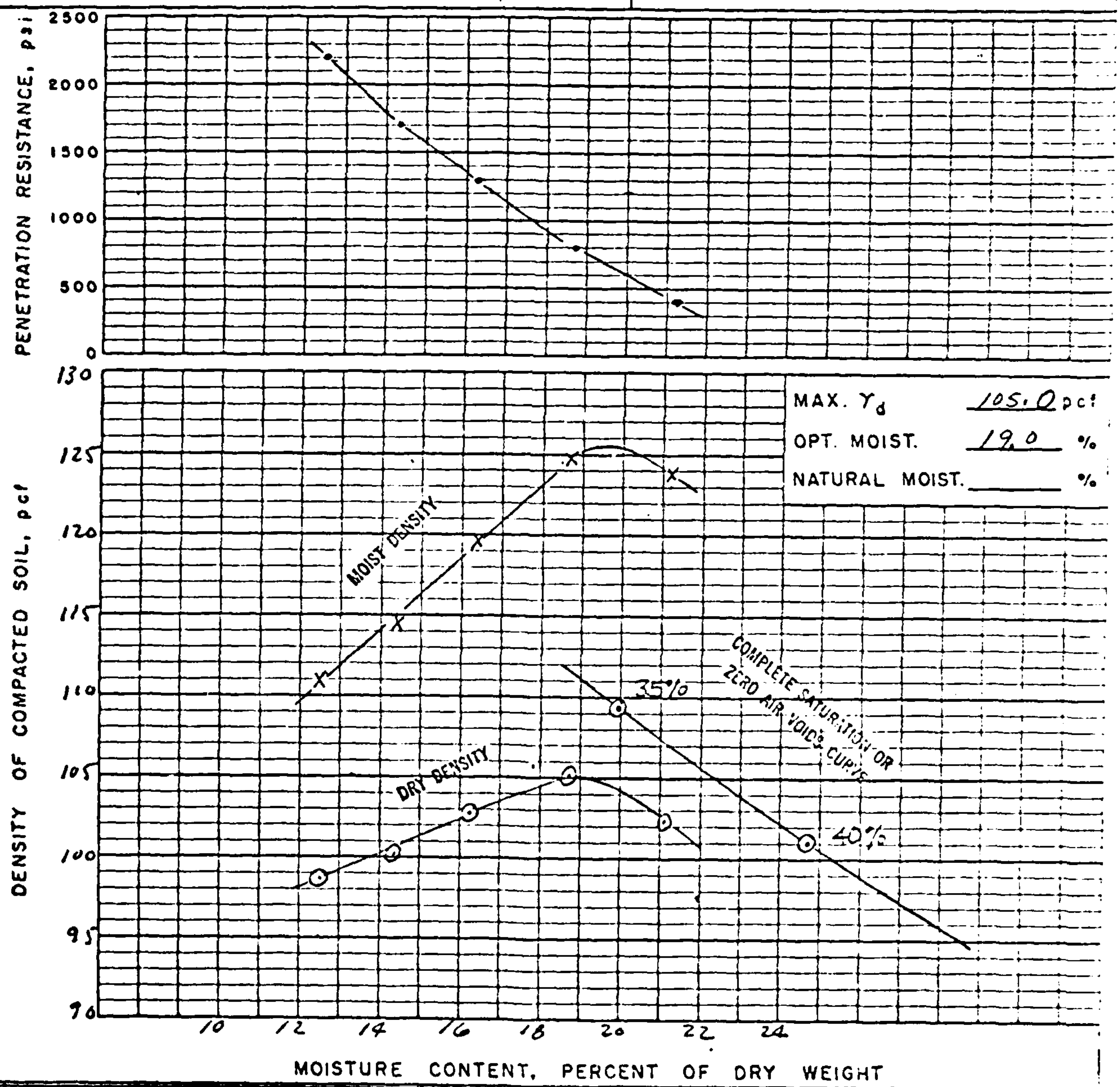
SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.70 ; PLUS NO. 4 ______

CURVE NO. 1 OF 11

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ______

OTHER TEST ☐ (SEE REMARKS)



REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO 70VL194

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO: 202.2 | LOCATION: ℄ Emer. Spwy. 3+00 | DEPTH: 5.0-10.0'

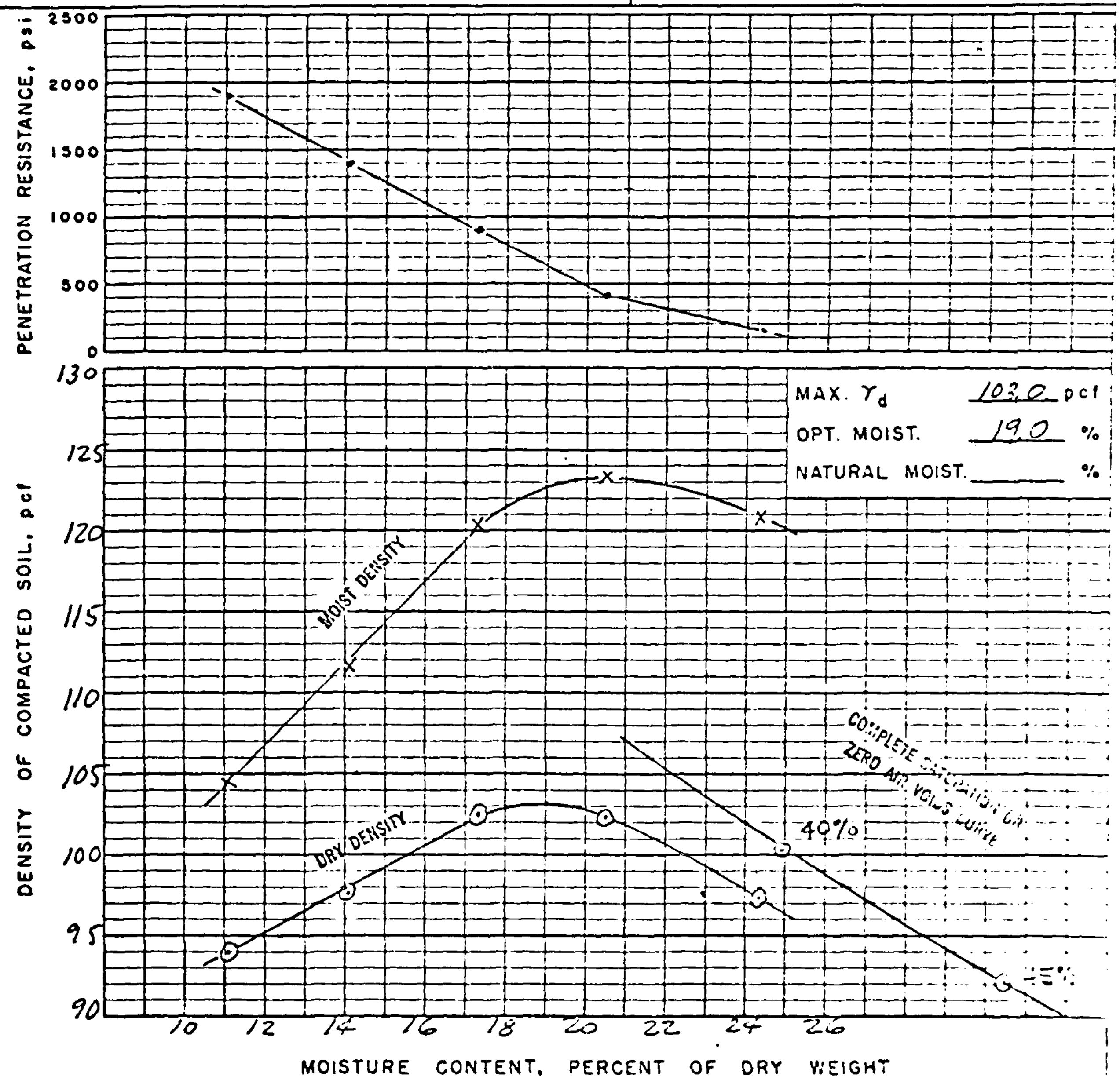
GEOLOGIC ORIGIN: LOESS | TESTED AT: SML-LINCOLN | APPROVED BY: J.N.J. | DATE: 8-20-70

CLASSIFICATION CL LL 39 PI 16 | CURVE NO. 2 OF 11

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 " | STD. (ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.68 ; PLUS NO. 4 ____ | MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70V1194

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 Missouri

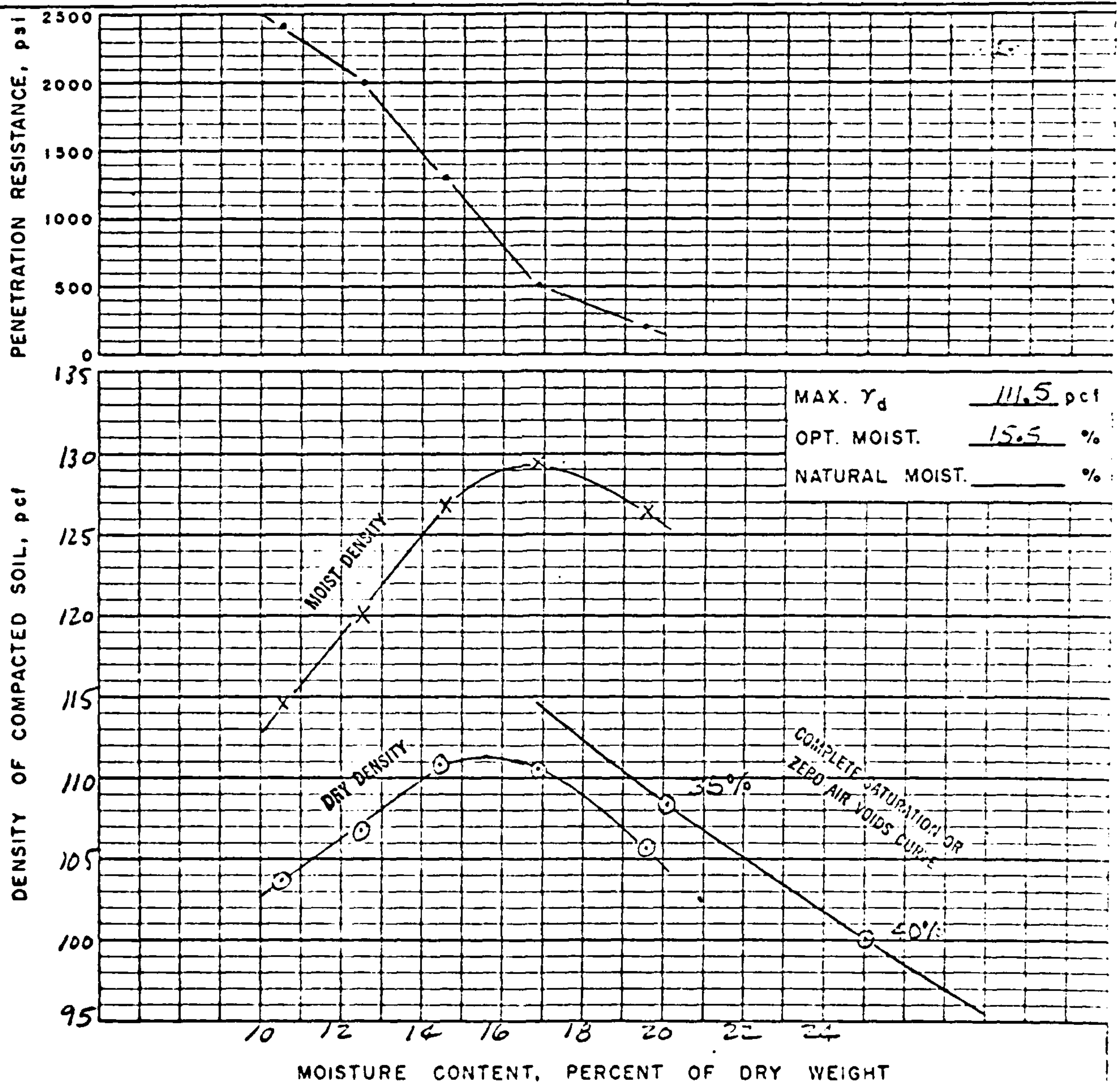
FIELD SAMPLE NO: 202.3
LOCATION: ℄ Emer. Spwy. 3+00
DEPTH: 11.0-14.0'

GEOLOGIC ORIGIN: LOESS
TESTED AT: SML-LINCOLN
APPROVED BY: G.N.G.
DATE: 8-20-70

CLASSIFICATION CL LL 33 PI 14
CURVE NO. 3 OF 11

MAX. PARTICLE SIZE INCLUDED IN TEST <#4"
STD. (ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.67
SPECIFIC GRAVITY (G_s) PLUS NO. 4
MOD. (ASTM D-1557) ☐; METHOD
OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 111.5 pcf
OPT. MOIST. 15.5 %
NATURAL MOIST. ____ %

REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70N194

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO: 206.1 | LOCATION: ℄ Emer. Spwy. 175' L 2+00 | DEPTH: 1.0'-6.0'

GEOLOGIC ORIGIN: LOESS | TESTED AT: SML-LINCOLN | APPROVED BY: G.N.G. | DATE: 8-20-70

CLASSIFICATION: CL LL 41 PI 19

MAX. PARTICLE SIZE INCLUDED IN TEST: < #4 "

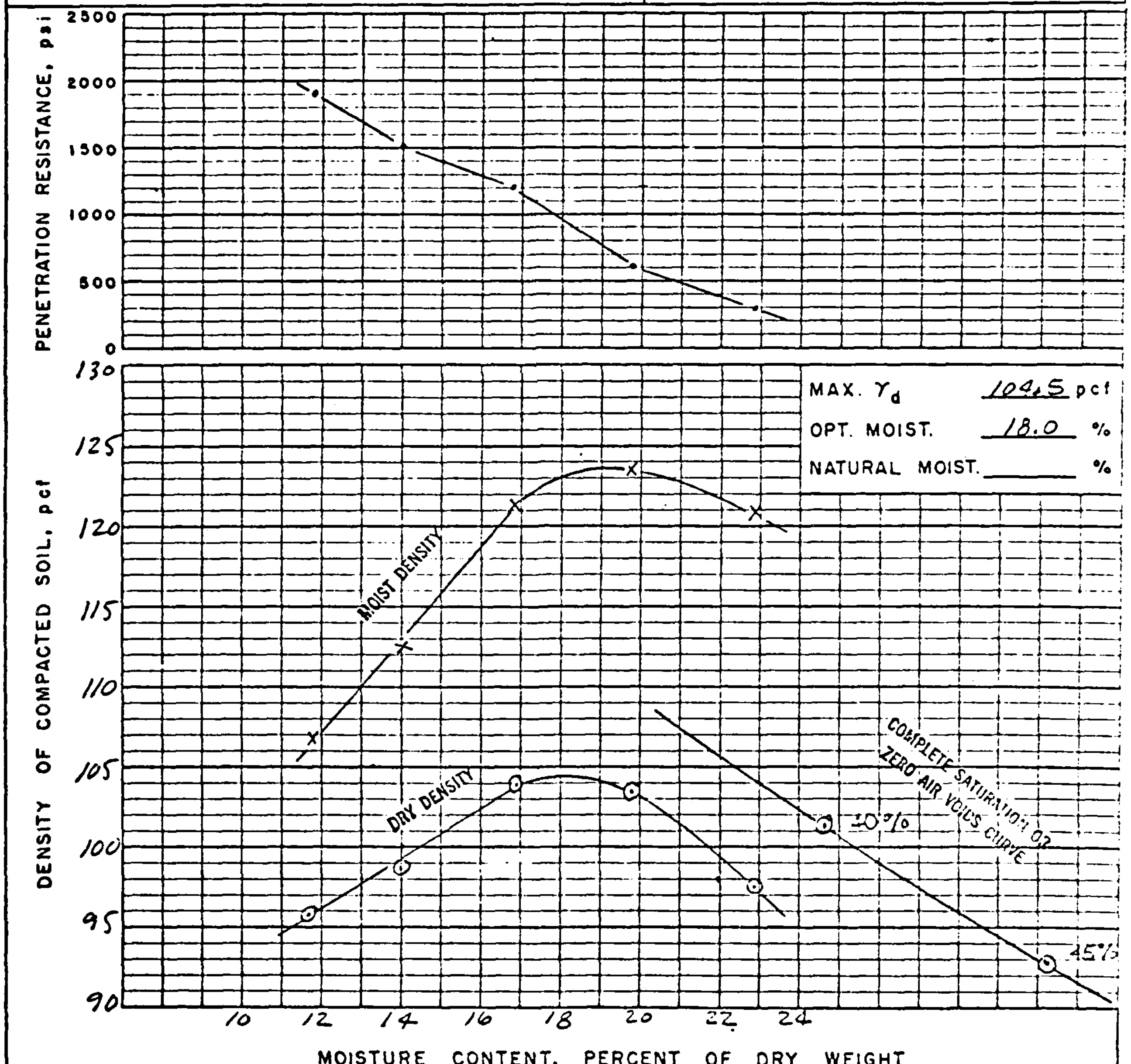
SPECIFIC GRAVITY (G_s): MINUS NO. 4: 2.70; PLUS NO. 4:

CURVE NO. 4 OF 11

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD

OTHER TEST ☐ (SEE REMARKS)



REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO 70W194

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO	LOCATION		DEPTH
206.2	℄ Emer. Spwy. 175' L 2+00		6.0'-10.0'
GEOLOGIC ORIGIN LOESS	TESTED AT SML-LINCOLN	APPROVED BY [signature]	DATE 3-20-70

CLASSIFICATION CL LL 37 PI 15

CURVE NO. 5 OF 11

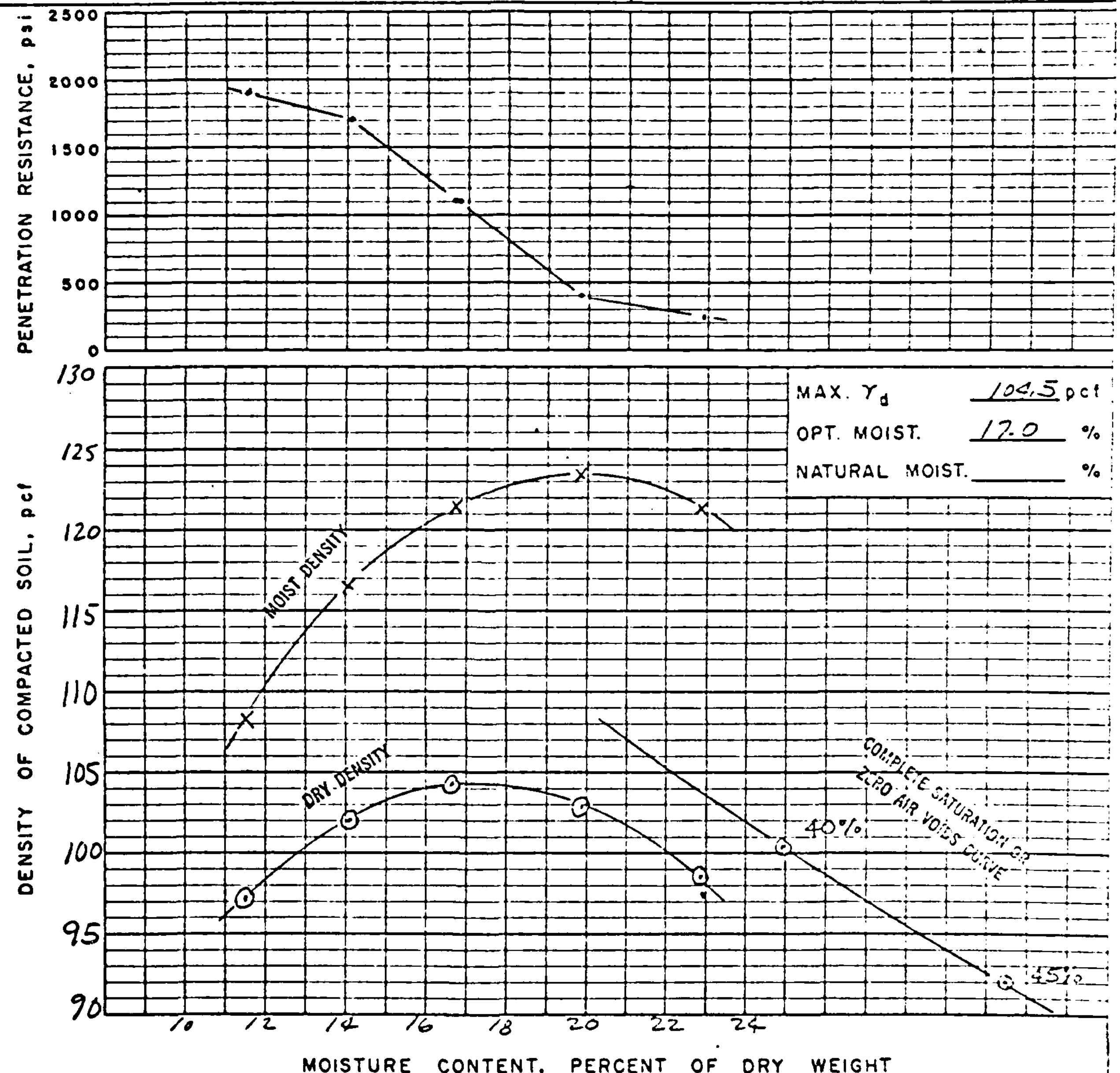
MAX. PARTICLE SIZE INCLUDED IN TEST <#4

STD. (ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.68; PLUS NO. 4 ____

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.5 pcf

OPT. MOIST. 17.0 %

NATURAL MOIST. ____ %

REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70W11946

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 MISSOURI

FIELD SAMPLE NO.: 208.1 | LOCATION: ℄ Emer. Spwy. 90' R. 4+00 | DEPTH: 1.0'-6.0'

GEOLOGIC ORIGIN: LOESS | TESTED AT: SML-LINCOLN | APPROVED BY: G.N.G. | DATE: 8-20-70

CLASSIFICATION CL LL 42 PI 21

MAX. PARTICLE SIZE INCLUDED IN TEST <#4"

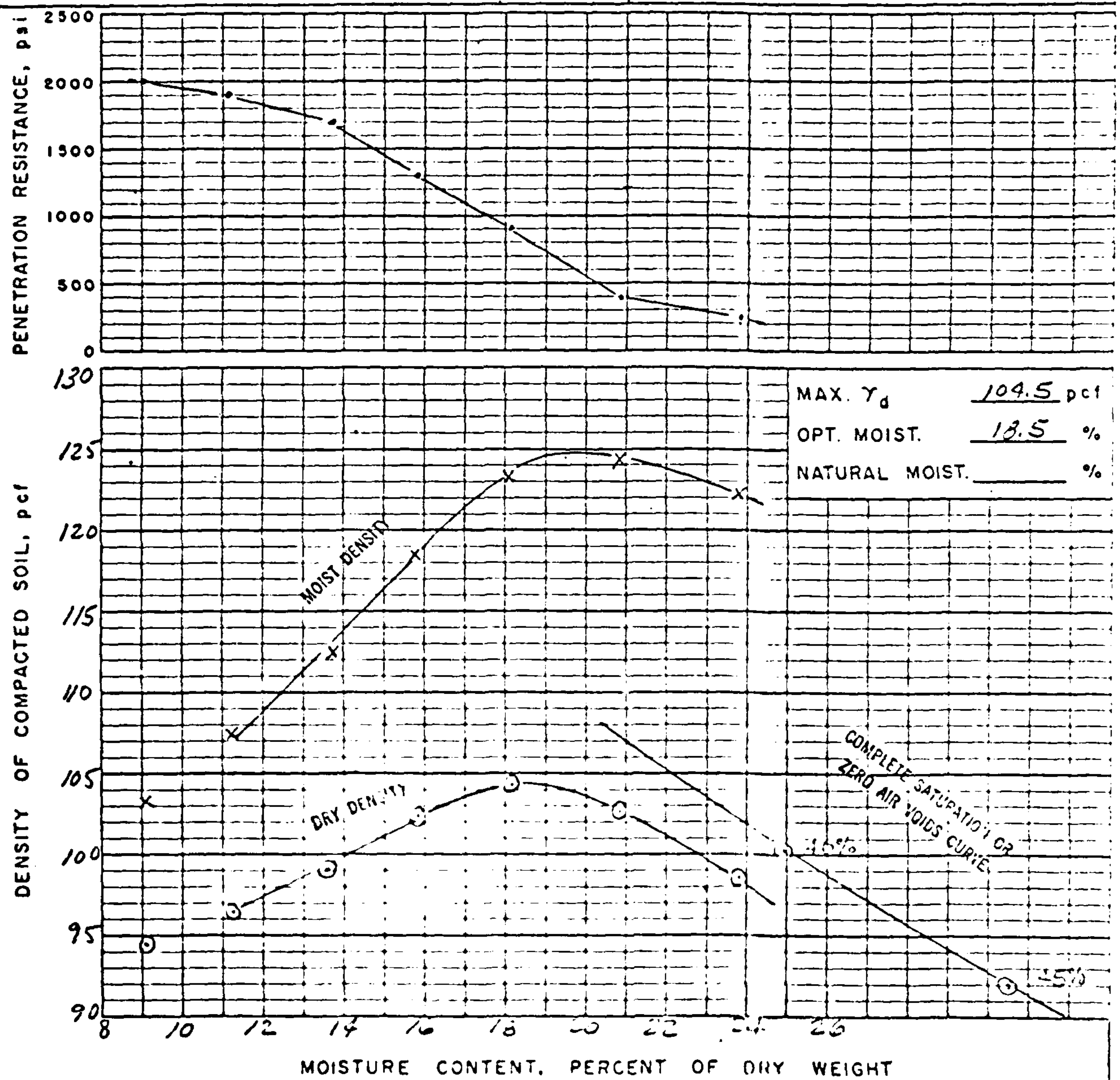
SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.68; PLUS NO. 4 ____

CURVE NO. 6 OF 11

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.5 pcf

OPT. MOIST. 18.5 %

NATURAL MOIST. ____ %

REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70W11947

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 MISSOURI

FIELD SAMPLE NO: 2083 | LOCATION: ℄ Emer. Spwy. 90' R, 4+09 | DEPTH: 6.0-11.0'

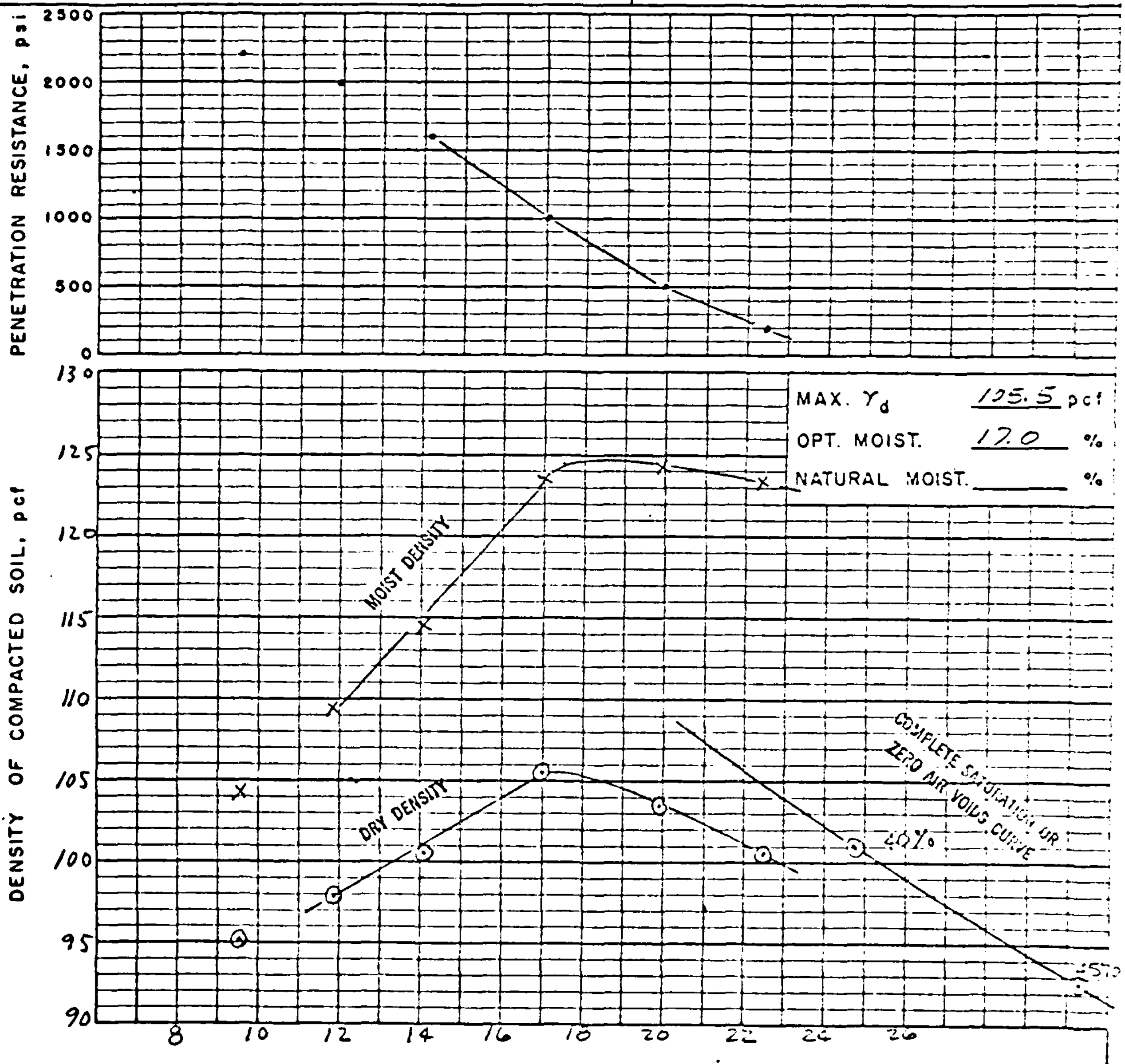
GEOLOGIC ORIGIN: LOESS | TESTED AT: SML-LINCOLN | APPROVED BY: | DATE: 8-20-70

CLASSIFICATION CL LL 37 PI 15 | CURVE NO. 7 OF 11

MAX. PARTICLE SIZE INCLUDED IN TEST <#4 | STD. (ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.70; PLUS NO. 4 | MOD. (ASTM D-1557) ☐; METHOD

OTHER TEST ☐ (SEE REMARKS)



REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70W1943

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

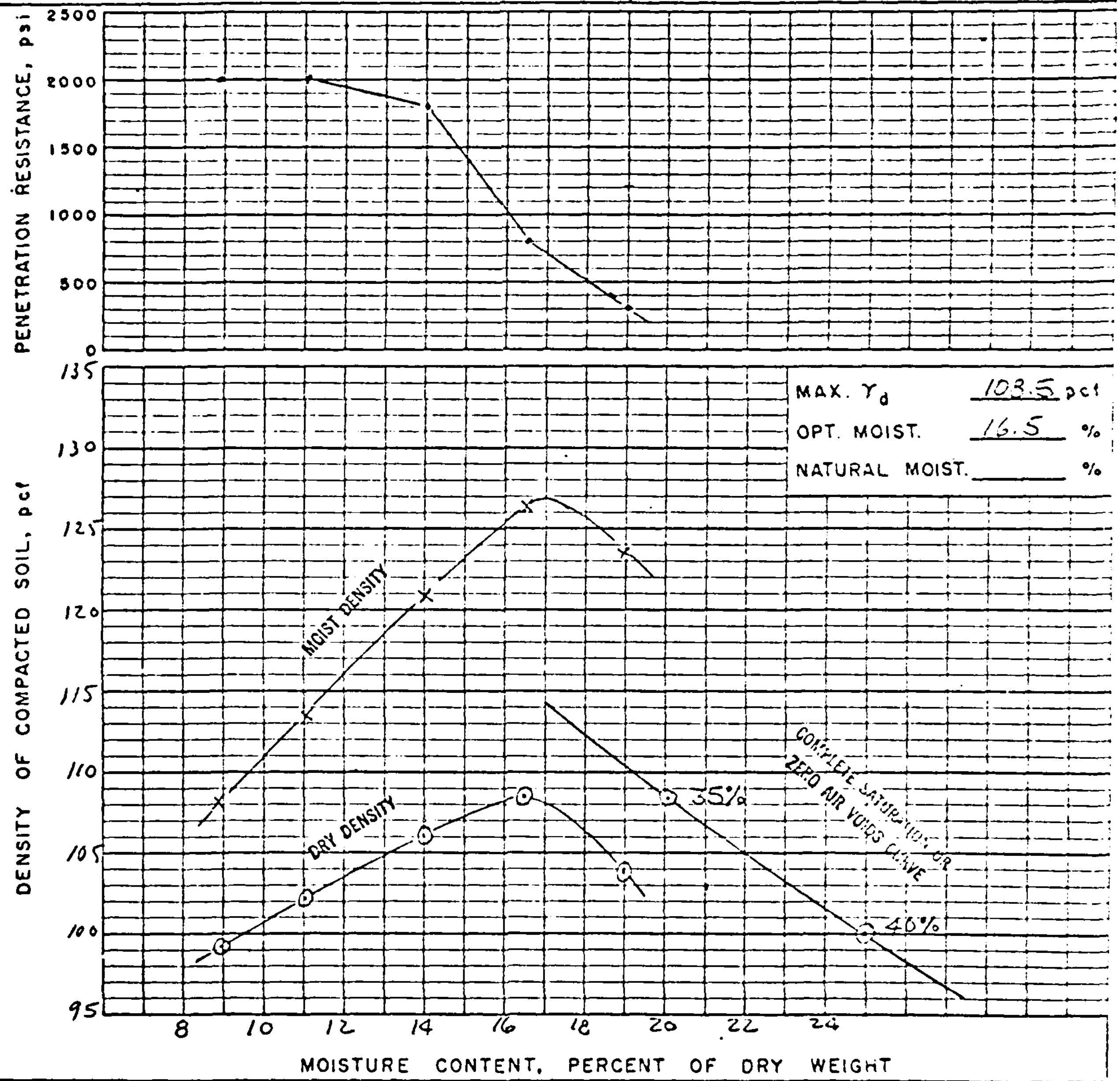
PROJECT and STATE: Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO: 101.1
LOCATION: Borrow, D+50 11+05
DEPTH: 1.0'-5.0'

GEOLOGIC ORIGIN: Alluvium
TESTED AT: SML-LINCOLN
APPROVED BY: G.N.G.
DATE: 3-20-70

CLASSIFICATION CL LL 31 PI 10
MAX. PARTICLE SIZE INCLUDED IN TEST <#4"
SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.67
PLUS NO. 4 ______

CURVE NO. 8 OF 11
STD. (ASTM D-698) ☒; METHOD A
MOD. (ASTM D-1557) ☐; METHOD ______
OTHER TEST ☐ (SEE REMARKS)



REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO 70K11849

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

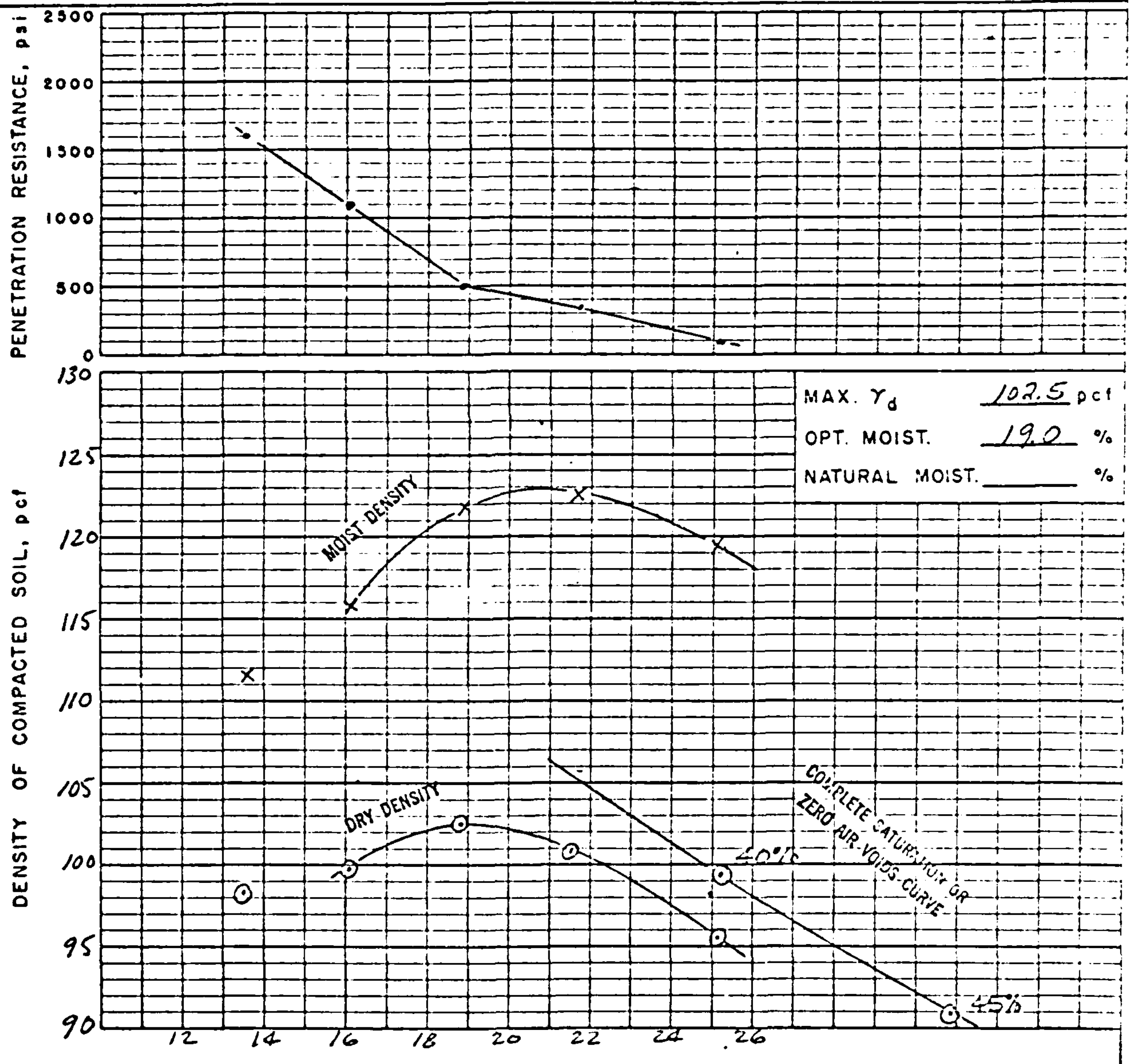
PROJECT and STATE: Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO: 102.1 | LOCATION: Borrow, F+50 6+00 | DEPTH: 2.0 - 3.0'

GEOLOGIC ORIGIN: Alluvium | TESTED AT: SML-LINCOLN | APPROVED BY: G.N.G. | DATE: 8-10-70

CLASSIFICATION: CL LL: 45 PI: 25
MAX. PARTICLE SIZE INCLUDED IN TEST: < #4
SPECIFIC GRAVITY (G_s) { MINUS NO. 4: 2.65 ; PLUS NO. 4: ______

CURVE NO. 9 OF 11
STD. (ASTM D-698) ☒; METHOD A
MOD. (ASTM D-1557) ☐; METHOD ______
OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 102.5 pcf
OPT. MOIST. 19.0 %
NATURAL MOIST. ______ %

REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO. 70W1950

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Little Sni-a-bar #1 MISSOURI

FIELD SAMPLE NO	LOCATION		DEPTH
102.2	Borrow F+50, 6+00		3.0' - 5.0'
GEOLOGIC ORIGIN: Alluvium	TESTED AT: SML-LINCOLN	APPROVED BY: G.N.G	DATE: 8-20-70

CLASSIFICATION CL LL 30 PI 10

MAX. PARTICLE SIZE INCLUDED IN TEST < #4"

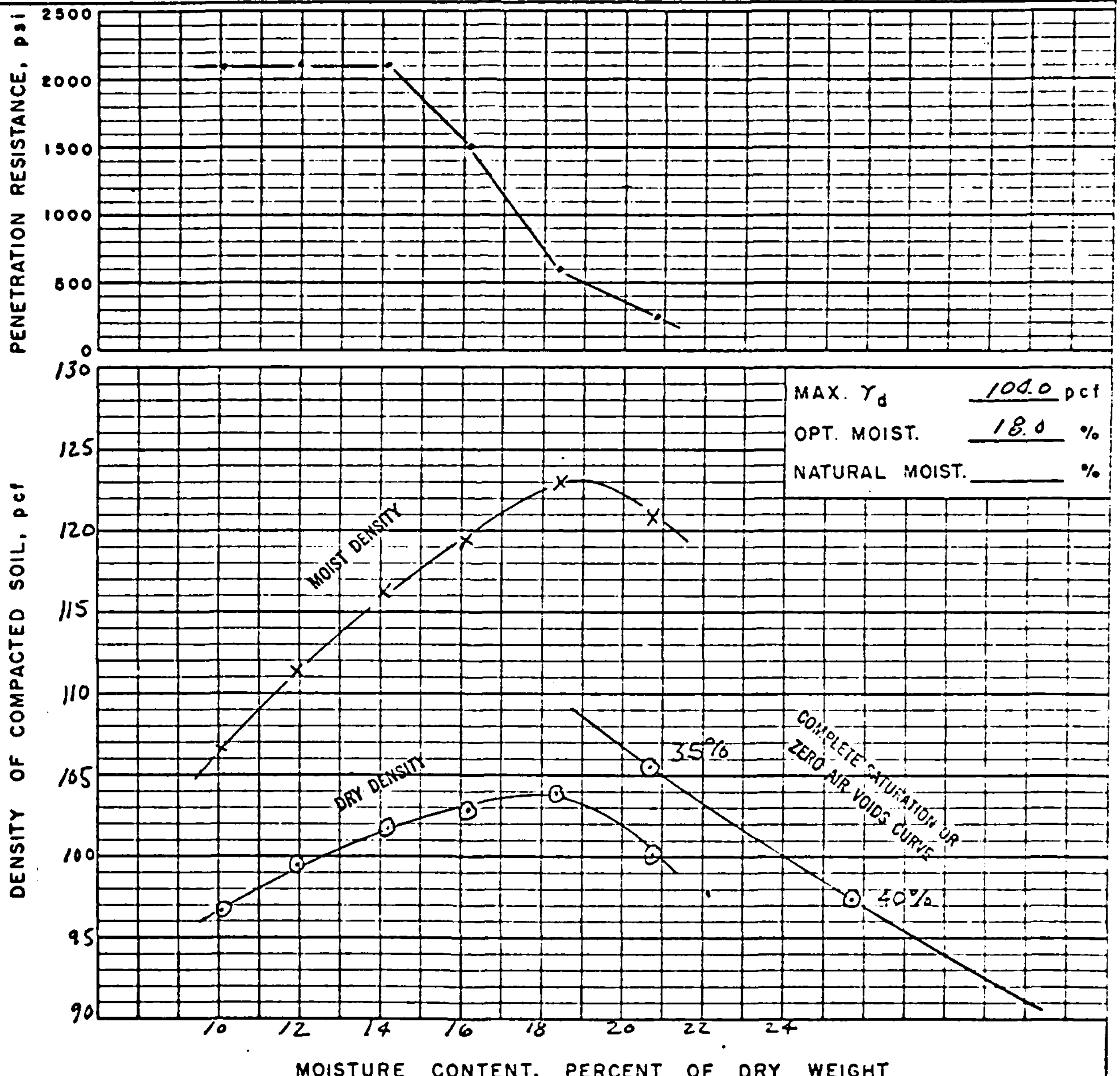
SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.60; PLUS NO. 4 ____

CURVE NO. 10 OF 11

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.0 pcf

OPT. MOIST. 18.0 %

NATURAL MOIST. ____ %

REMARKS

Form SCS 352
Rev. 5-65

LABORATORY NO 70W125

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

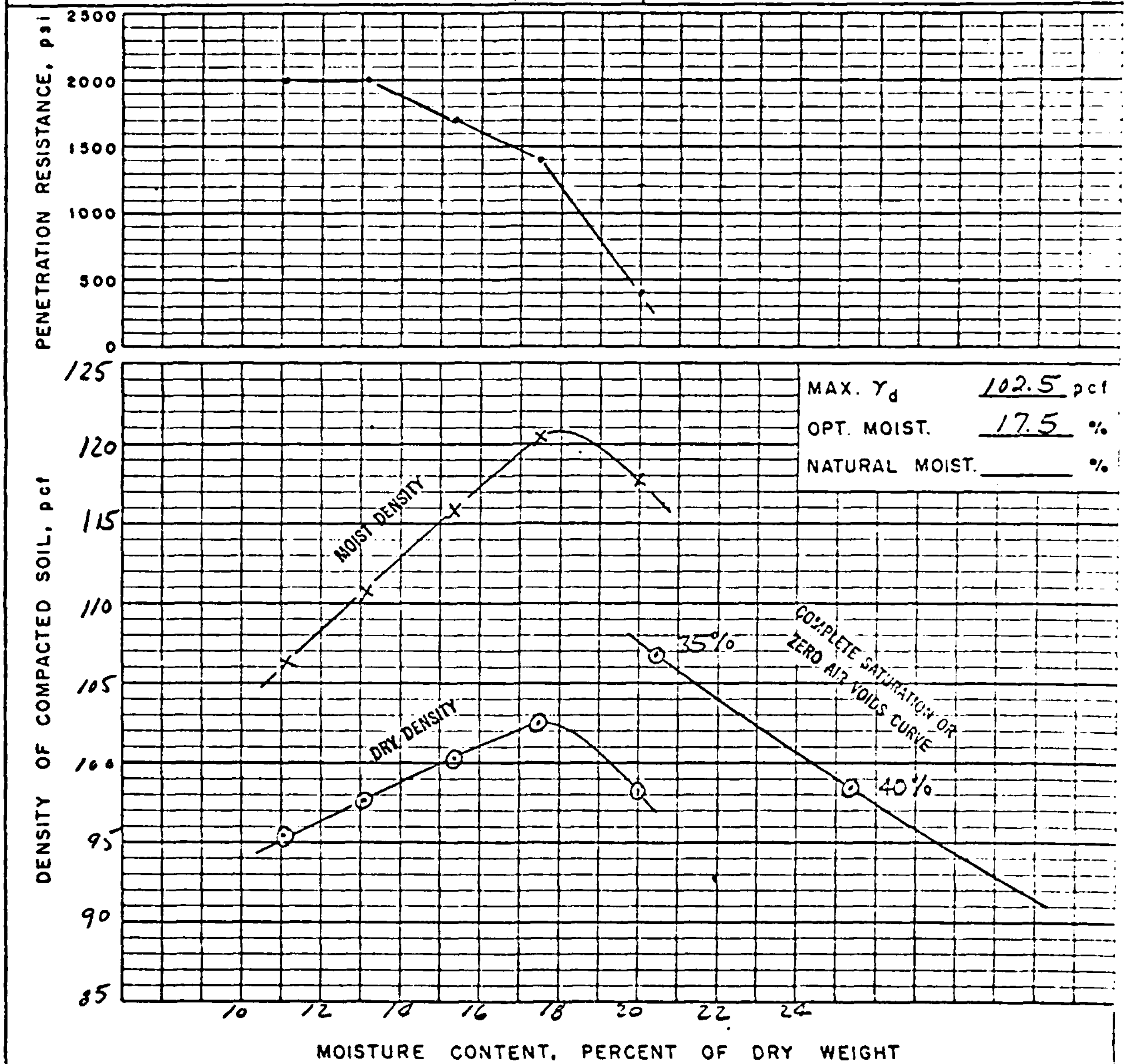
PROJECT and STATE: Little Sni-a-bar #1 Missouri

FIELD SAMPLE NO: 105.1
LOCATION: Borrow, I+50 8+00
DEPTH: 0.0'-1.0'

GEOLOGIC ORIGIN: Alluvium
TESTED AT: SML-LINCOLN
APPROVED BY: G.N.G.
DATE: 3-20-70

CLASSIFICATION CL-ML LL 28 PI 6
MAX. PARTICLE SIZE INCLUDED IN TEST < #4
SPECIFIC GRAVITY (G_s) MINUS NO. 4 2.63; PLUS NO. 4 ___

CURVE NO. 11 OF 11
STD. (ASTM D-698) ☒; METHOD A
MOD. (ASTM D-1557) ☐; METHOD ___
OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 102.5 pcf
OPT. MOIST. 17.5 %
NATURAL MOIST. ___ %

REMARKS

Form SCS 357
Rev 6-65

MATERIALS TESTING REPORT | **U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE**

SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: SNI-A-BAR SITE #1 MISSOURI
DATE: 2-4-70

METHOD OF ANALYSIS: SWEDISH CIRCLE
ANALYZED AT: S.M.L. LINCOLN, NE.
APPROVED BY: G.N.G.

	SOURCE AND USE OF MATERIALS	CLASSIFICATION	γ_d (pcf)	γ_m (pcf)	γ_{sat} (pcf)	γ_{sub} (pcf)	ϕ (deg)	tan ϕ	c (psf)	REMARKS
①	Found.	CL-ML	91.7		119.5	57.0	25	.466	100	
②	Found.	CL	94.5		121.5	59.0	23	.424	150	
③	Embank.	CL	96.5	115.0	123.0	60.5	12.5	.222	375	
④										
⑤										
⑥										
⑦										
⑧										

TRIAL NO.	SLOPE	CONDITIONS	F_s
		Maximum Section @ Station 12+00	
1Up	2½:1	Fulldrawdown-No berm-Arc cut thru emb(12.5°-375) only.	1.59
2Up	2½:1	Fulldrawdown-10'berm @ elev. 774.0-Arc cut thru emb. (12.5°-375) & 9' found(25°-100).	1.29
2AUp	2½:1	Same conditions as trial #2 except found(23°-150).	1.29
3Up	2½:1	Same conditions as trial #2A.	1.33
4Up	2½:1	Same conditions as trial #2A.	1.41
5Dn	2½:1	No drain-No berm-Arc cut thru emb(12.5°-375) only.	1.69
6Dn	2½:1	No drain-10'berm @ elev. 774.0-Arc cut thru emb.(12.5°-375) & 9' found(23°-150)	1.38
7Dn	2½:1	Same conditions as trial #6.	1.36
8Dn	2½:1	Same conditions as trial #6.	1.50
		Flood Plain Section @ Station 12+60	
9Up	2½:1	Fulldrawdown-10'berm @ elev. 774.-Arc cut thru emb.(12.5°-375) & 11' found(23°-150).	1.51
10Up	2½:1	Fulldrawdown-10'berm @ elev. 774-Arc cut thru emb.(12.5°-375) & 22' found(23°-150).	1.42
10AUp	2½:1	Same conditions as trial #10 except found(25°-100).	1.42
11Up	2½:1	Same conditions as trial #10.	1.42
11AUp	2½:1	Same conditions as trial #10A.	1.39
12Up	2½:1	Same conditions as trial #10A.	1.59

Continued on sheet 2 of 4

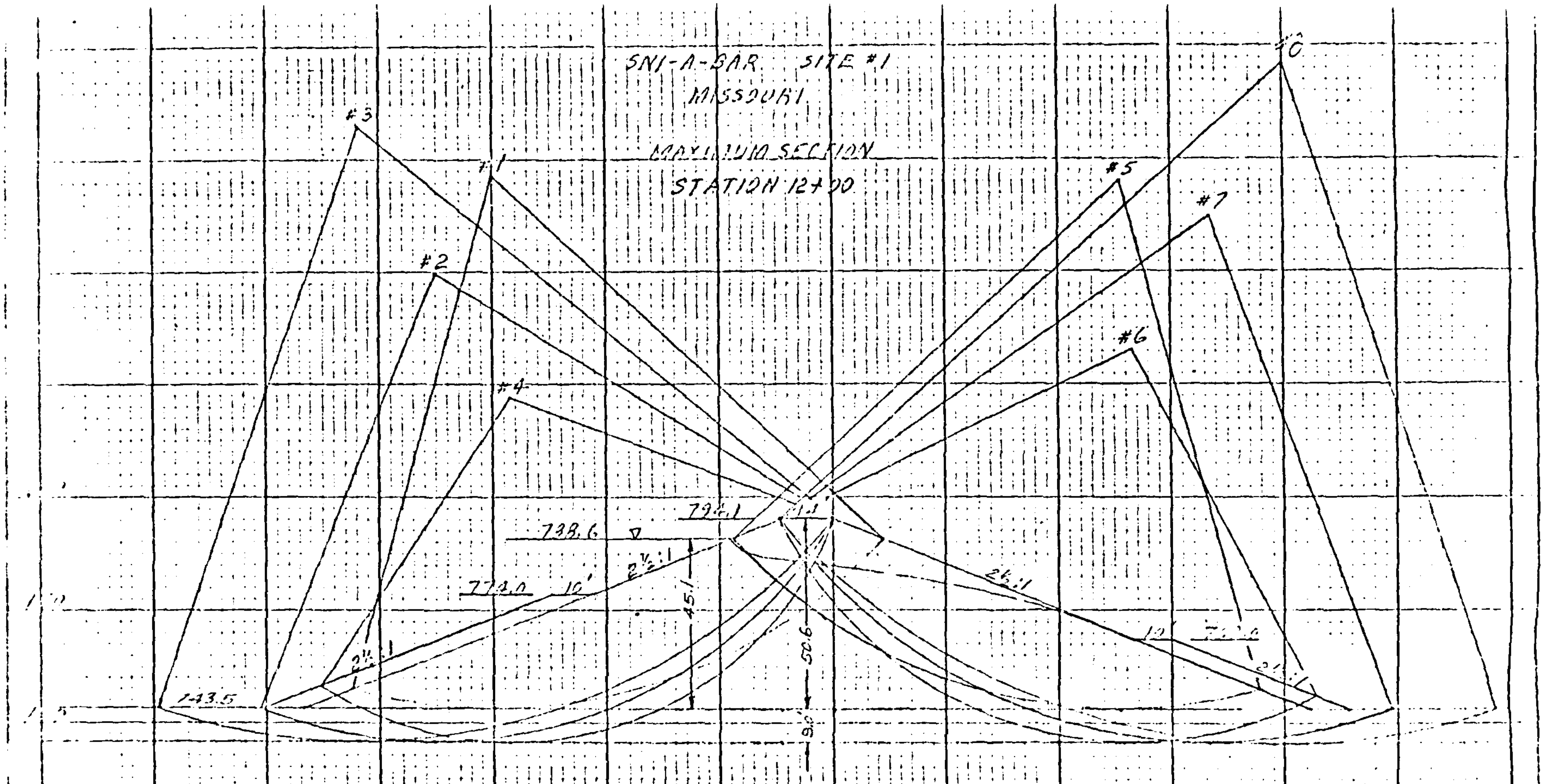
Form SCS 357
Rev 6-65

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: SNI-A-BAR SITE #1 MISSOURI
DATE: 8-1-79
METHOD OF ANALYSIS: SWEDISH CIRCLE
ANALYZED AT: S.M.L., LINCOLN, NB
APPROVED BY: G.N.G.

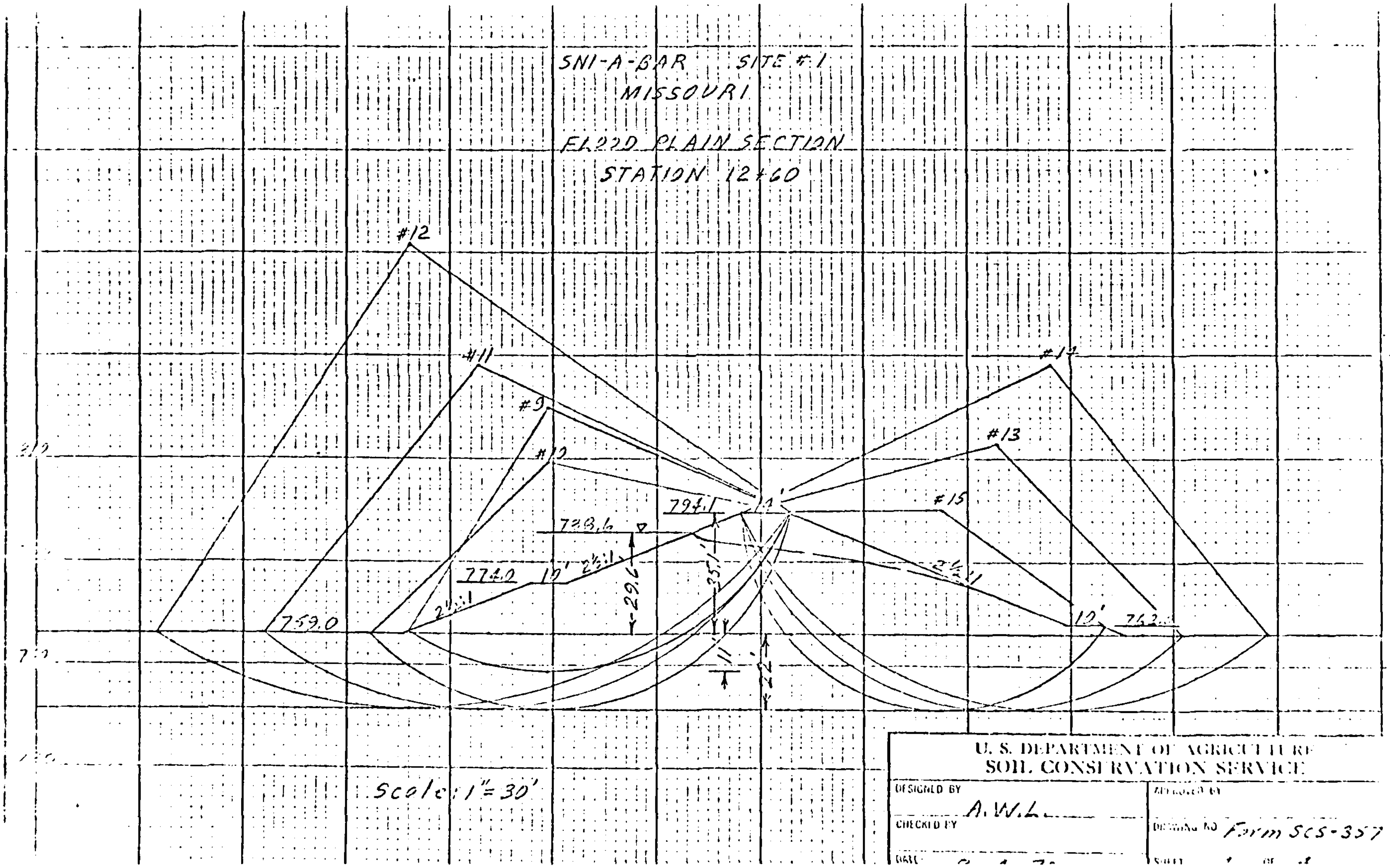
SOURCE AND USE OF MATERIALS	CLASSIFICATION	Yd (pcf)	Ym (pcf)	Ysat (pcf)	Ysub (pcf)	Φ (deg)	tan Φ	c (psf)	REMARKS
①									
②									
③									
④									
⑤									
⑥									
⑦									
⑧									

TRIAL NO.	SLOPE	CONDITIONS	F_s
		Flood Plain Section (Continued.)	
13Dn	2½:1	No drain-10' berm @ elev. 762.0 - Arc cut thru emb. (12.5°-875) & 22' found. (25°-100).	1.40
14Dn	2½:1	Same conditions as trial #13.	1.47
15Dn	2½:1	Same conditions as trial #13.	1.62



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY A.W.L	APPROVED BY
CHECKED BY RDL	DRAWING NO Form SCS-3??
DATE ?-1-??	SHEET 3 OF 4


SNI-A-BAR SITE #1
MISSOURI
FLOOD PLAIN SECTION
STATION 12+60
#12
#11
#9
#10
#14
#13
#15
794.1
783.6
774.0
759.0
10'
2½:1
29.6
35'
11'
22'
Scale: 1" = 30'
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
DESIGNED BY A.W.L.
CHECKED BY
DATE
APPROVED BY
DRAWING NO Form SCS-357
SHEET

Form SCS-376A
Sheet 1 of ____
10-59

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County Lafayette ; ____ ¼, NW NE ¼, Sec. 9 8, T 49N R 27W ; Watershed Little Sni-A-Bar

Subwatershed ____ Fund class WP-08-15 (FP-2, WP-1, etc.) Site number 1 Site group I Structure class a

Investigated by [signature] (signature and title) Equipment used Failing 1500 (Type, size, make, model, etc.) Date 3-3-70

SITE DATA

Drainage area size 14.37 sq. mi., 9197 acres. Type of structure DI 48" R/C Purpose Floodwater

Direction of valley trend (downstream) N Maximum height of fill 49 feet. Length of fill 1200 feet

Estimated volume of compacted fill required 97,715 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	651	105	29
Floodwater	3080	318.6	43.6

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Cherokee Prairie River Hill Loess Topography rolling Attitude of beds: Dip -- Strike --

Steepness of abutments: Left 9 percent; Right 9 percent. Width of floodplain at centerline of dam 450 feet

General geology of site: The site is located in a transitional area from National land Resource Area 107, the Iowa and Missouri Loess Hills and Resource Area 112, the Cherokee Prairies. The modified loess occurs on the upper slopes and ridges. The underlying bedrock is shale and sandstone of the Kansas City Group, Missourian Series, of the Pennsylvanian System.

U. S. DEPARTMENT OF AGRICULTURE
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Little Sni-A-Bar   Site #1

FORM SCS-376B
REV. 2-64
SHEET 2 OF ____

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE ℄ of Dam, Principal Spillway, Emergency Spillway, Channel, Drainage, Borrow
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
5" Slat Auger	31	8		12 bag	8 bag
3" Shelby		2	3 Shelby		~~4 bag~~
Std. Split Tube		2			4 Jar
3" Tri-cone bit	2				
TOTAL	33	12	3	12	16

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The abutments are modified loess classified as firm to stiff clay (CL). The alluvium of the foundation area is clayey silt (ML) in the upper part and a silty clay (CL) in the lower part. The alluvium forms the foundation of the principal spillway. Shale is the predominate underlying bedrock, however, a prominant sandstone bed was encountered in test holes 11 and 12. The bed is absent in test hole 10 which is located 25 feet to the left. Refusal on limestone was encountered in test holes 5, 6, 7, 401, and 402. Shale is the uppermost bedrock along the centerline of the principal spillway. The emergency spillway cuts on the left abutment will be the principal source of borrow material. Other borrow will be available from the alluvium within easy haul distance. The stream channel meanders across the centerline of the dam. Channel deposits of flat shale and sandstone gravel was 2.5 to 3 feet deep in test holes 401 and 402. The underlying alluvium is classified silty clay (CL). The stream channel appears stable at the present, however, some shifting of the bed load gravels will occur seasonally.

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SCS-376C
REV. 2-64
SHEET 3 OF ____

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED		SUBWATERSHED	COUNTY	STATE	
Little Sni-A-Bar			Lafayette	Missouri	
SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)		DATE
1	I	a	Neil F. Edmonds		3-3-70

INTERPRETATIONS AND CONCLUSIONS

Foundation

The bedrock surface drops abruptly between test holes 10 and 11, a distance of 25 feet. Some gravel was noted below 13 feet in test holes 9 and 10 but no slabs or boulders were encountered as might usually be expected. Shale cover extends as far as the sandstone and no seepage hazards are apparent. The alluvium is generally uniform throughout the foundation area. The upper 10 to 14 feet is classified as ML, soft when wet, and contains a noticeable amount of very fine sand below the upper layer of modern sediments. This is underlain by yellowish brown and gray, wet, soft alluvium frequently encountered in the glacial till and loess soil areas. The material is classified as very silty CL. A greenish gray firm CL occurs above the bedrock on the left side of the valley. Shelby tube samples were taken of these three representative materials. The greenish gray material was difficult to sample since some gravel was encountered. This gravel occurs in thin lens and was not noticeable when augering the holes. The consistency of the alluvium becomes firmer near the abutments as classified in test holes 4, 9 and 10. Test holes 601 through 606 were drilled 95 feet downstream from the centerline. Some lens or discontinuous strata of iron concretions and flat shale and sandstone gravels were encountered, however, all materials were mixed in clay and classified as CL. No materials classified as permeable were encountered. Refusal in the test holes at the centerline was on the limestone bed encountered from 35 to 37 feet in test hole 11.

Principal Spillway

The principal spillway is to be relocated and undisturbed samples were taken at ℄ Station 14+00. The refusal in test hole 305, station 3+55, correlates well with the limestone bed in test hole 11 at the centerline. This appears to be a sound bed.

Emergency Spillway and Borrow Areas

The emergency spillway cuts are in the loess and loess soil and will furnish the major part of the borrow material for the dam. Other borrow can be obtained from the alluvial area below the crest elevation, of the principal spillway, however, the existing pond and high water levels may limit the depth and location of the material.

Channel

It was not possible to investigate the designated channel sections. The two holes drilled in the channel are believed representative of the channel deposits throughout the foundation area.

PROJECT ENGINEER'S RECOMMENDATIONS
LITTLE SNI-A-BAR
STRUCTURE #1

1. FOUNDATION

General Statement - The foundation on this site is compressible, there will be settlement. I recommend a combination foundation and chimney drain. The chimney drain to be in contact with the steep rock ledge on the right abutment to pick up any water that may seep along the ledge from differential settlement.

1.1 Core - After consulting with the state Design Engineer, I moved the center line of the structure 150 feet up stream as now shown on the Geologic sheets. The reason for moving the center line was to eliminate the cost of a long outlet channel and to eliminate the double excavation cost of channel and core excavation. The core is now superimposed on the moderately meandering channel. For the simplicity of computing yardages and of establishing bid items, the core will extend from each end of the dam to approximately 9 + 50 and 13 + 90. The excavation between stations 9 + 50 and 13 + 90 will be called channel cleanout. This excavation will be made to a depth to function as a core trench cutoff. The following core grades are recommended:

Station	Elevation
6 + 00	789
6 + 80	782
7 + 50	774
9 + 00	765
9 + 20	760
9 + 60	743
13 + 80	745
15 + 10	752
15 + 30	765
16 + 10	778
16 + 90	785
17 + 90	792

Rock ledge should be inspected and sloped. All projections should be removed to avoid creating an opening during settlement.

1.2 Channel Cleanout - See attached cross sections.

Station	Elevation	Width	Slope
Section A	745.0	32	1 : 1
Section A + 50			1 1/2 : 1
Section B	744.0	28	1 1/2 : 1
Section C	743.5	20	1 1/2 : 1
Section D	743.0	30	1 1/2 : 1
Section E	743.0	32	1 1/2 : 1 +
Section F	743.0	25	1 1/2 : 1
Section F + 50			1 : 1
Section G	743.0	38	1 : 1

If consolidation in the foundation is less than anticipated, consideration should be given to changing all the side slopes to 1 : 1 to reduce the excavation yardage.

1.3 Structure excavation - Should remove all ML material. This will be approximately the pipe grade. Grade will not be known until riser height is determined. To eliminate shear along the cut slopes when consolidation of the foundation occurs, the minimum side slopes should be 2 : 1 with a 12 foot bottom.

2. CHANNEL OUTLET

A plunge basin will be required to stabilize the deep cut slopes. A 15 foot wide outlet with 2 : 1 slopes is recommended.

3. BORROW

Needed - 97,715 x 1.3 = 127,000 cu. yd.
Available - 72,000 c.y. from emergency; most of it is good quality CL material. There is an adequate quantity of ML material a short distance up stream of the dam to complete the borrow requirement. The CL should be used for backfilling the excavated areas and building the inner part of the dam. Shear test of borrow is not requested since the CL material from the emergency spillway is a good quality material that will be used in the center of the dam.

Based on laboratory classifications the following samples may be composited:

202.1	202.2	202.3
206.1	206.2	206.3
208.1	208.2	

Gerald McElhiney
Project Engineer, Higginsville, Mo.

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvalinear unit hydrograph and SCS TR-20 program were used to develop the inflow hydrographs (see Plate D1). The inflow hydrograph for the 100-year flood was generated by the consultant using the TR-20 program.

   a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 36-hour probable maximum precipitation was taken from curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis District policy and guidance for hydraulics and hydrology. A 36-hour probable maximum storm was selected by the consultant because of the relatively large drainage area, time of concentration and length of downstream damage zone. This decision also gave an effective base flow ahead of the maximum 24-hour rainfall.

   b. Drainage area = 14.37 square miles (SCS).

   c. Time of concentration of runoff - 2.3 hours (SCS).

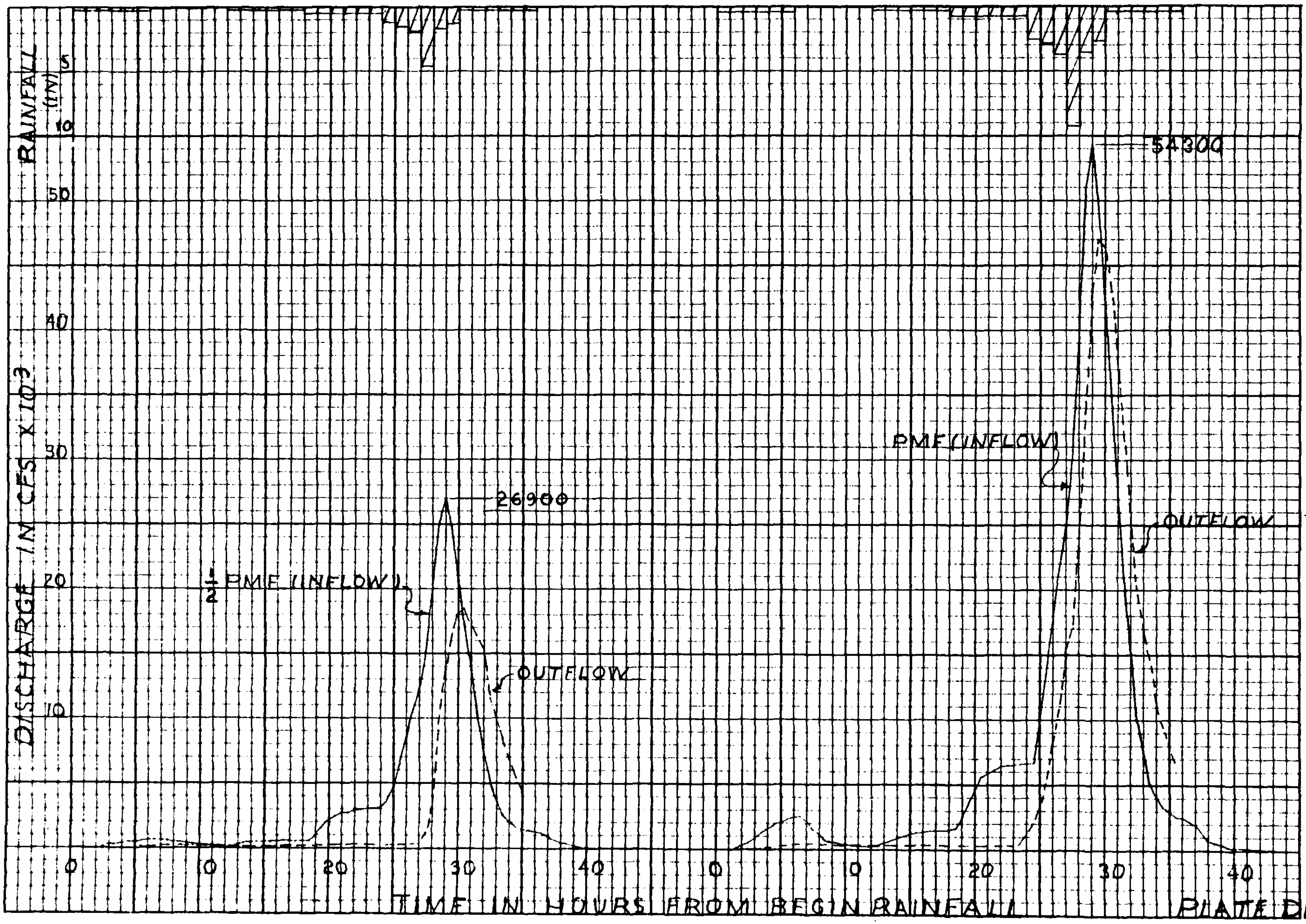
   d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMCIII). The initial pool elevation was assumed at the crest of the principal spillway. The (SCS AMCIII) antecedent storm conditions were also used for the 100-year storm event. This was done because base conditions (SCS AMCII) reflect only a maximum annual flood precedence condition on numerous watersheds. The 100-year event is rarer and would be preceded by a greater degree of saturation of the watershed. SCS AMCIII.

   e. The total 24-hour storm duration losses for the 100-year storm were 1.44 inches. The total losses for the 36-hour duration 1/2 PMF storm were 1.00 inch. The total losses for the PMF storm were 0.77 inch. These relatively low losses on the PMF storms are created by the longer storm duration of 36 hours. The watershed was determined to be made up predominately of Ladoga and Pershing soils which are, respectively, in the B and C Hydrologic Soil Group classifications. A grid weighting system and consideration of land usage gave a resultant SCS curve No. of 78 for SCS AMCII. These data are based on SCS runoff curve No. 90 and antecedent moisture conditions from SCS AMCIII.

   f. Average soil loss rates = 0.04 inch per hour approximately.

2. The weir/full pipe flow discharge ratings were developed for the principal spillway using standard formulas and criteria from SCS publication Design Manual EWP-5. The emergency spillway discharge rating was developed using the SCS emergency spillway computer program "RESIN" and the results compared closely with the values furnished by the SCS for both the emergency and principal spillways. The flows over the dam crest were based on the broad-crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; the coefficient C which varies with head was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods".

3. Floods were routed through the reservoir using the TR-20 program which uses the "Modified Puls" method to determine the capabilities of the spillways and dam embankment crest. A routing time interval of 0.5 hour was used. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D1.


RAINFALL (IN)
5
10
DISCHARGE IN CFS X 10³
50
40
30
20
10
26900
½ PMF (INFLOW)
OUTFLOW
54300
PMF (INFLOW)
OUTFLOW
0
10
20
30
40
0
10
20
30
40
TIME IN HOURS FROM BEGIN RAINFALL
PLATE D1